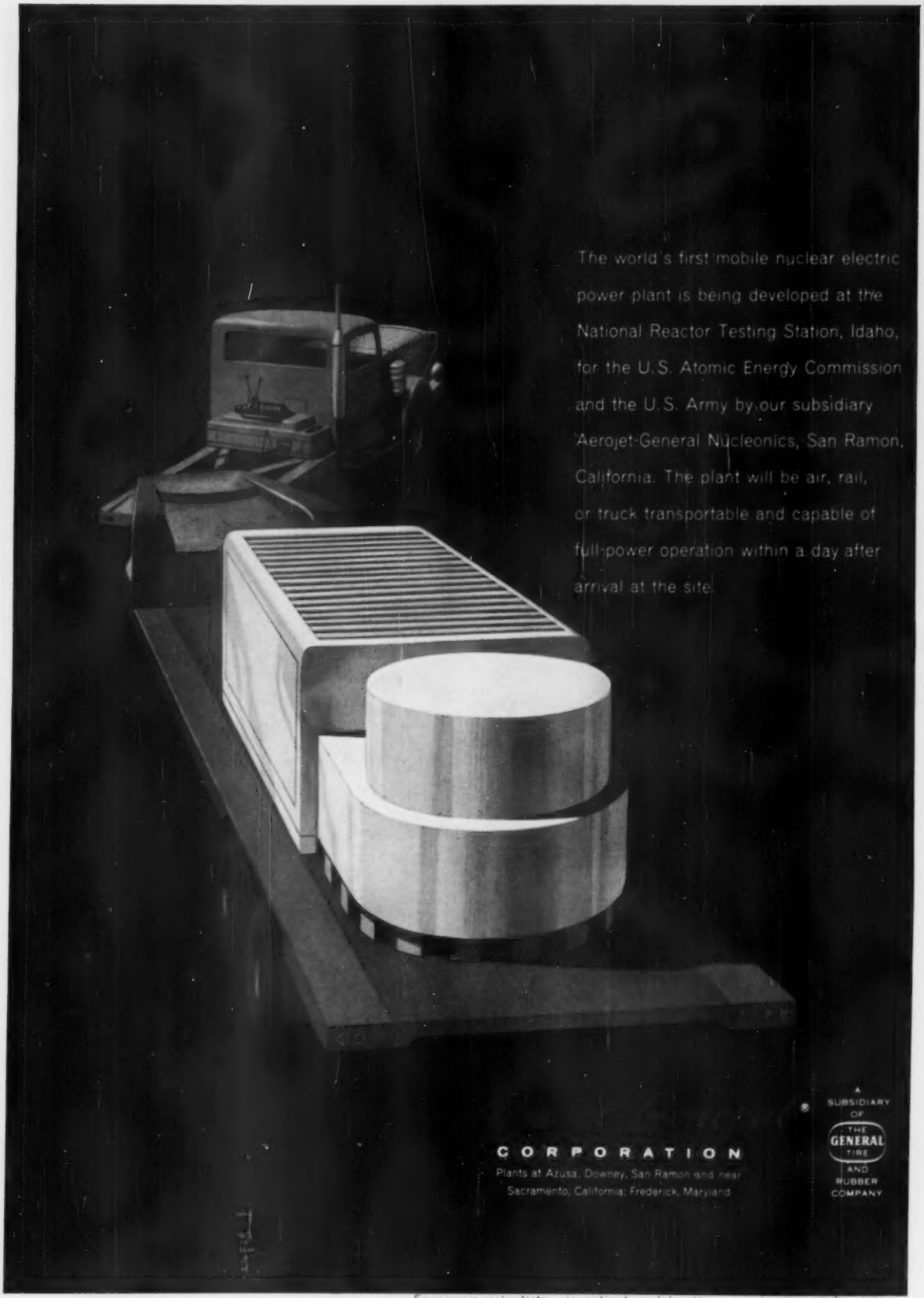
Aviation Week
and Space Technology

75 Cents

May 16, 1960

First Details Of DOD's Avionic Reliability Plan

Tiros Photographs Red Sea and Nile


The world's first mobile nuclear electric power plant is being developed at the National Reactor Testing Station, Idaho, for the U.S. Atomic Energy Commission and the U.S. Army by our subsidiary Aerojet-General Nucleonics, San Ramon, California. The plant will be air, rail, or truck transportable and capable of full-power operation within a day after arrival at the site.
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Plants at Azusa, Downey, San Ramon and near Sacramento, California; Frederick, Maryland
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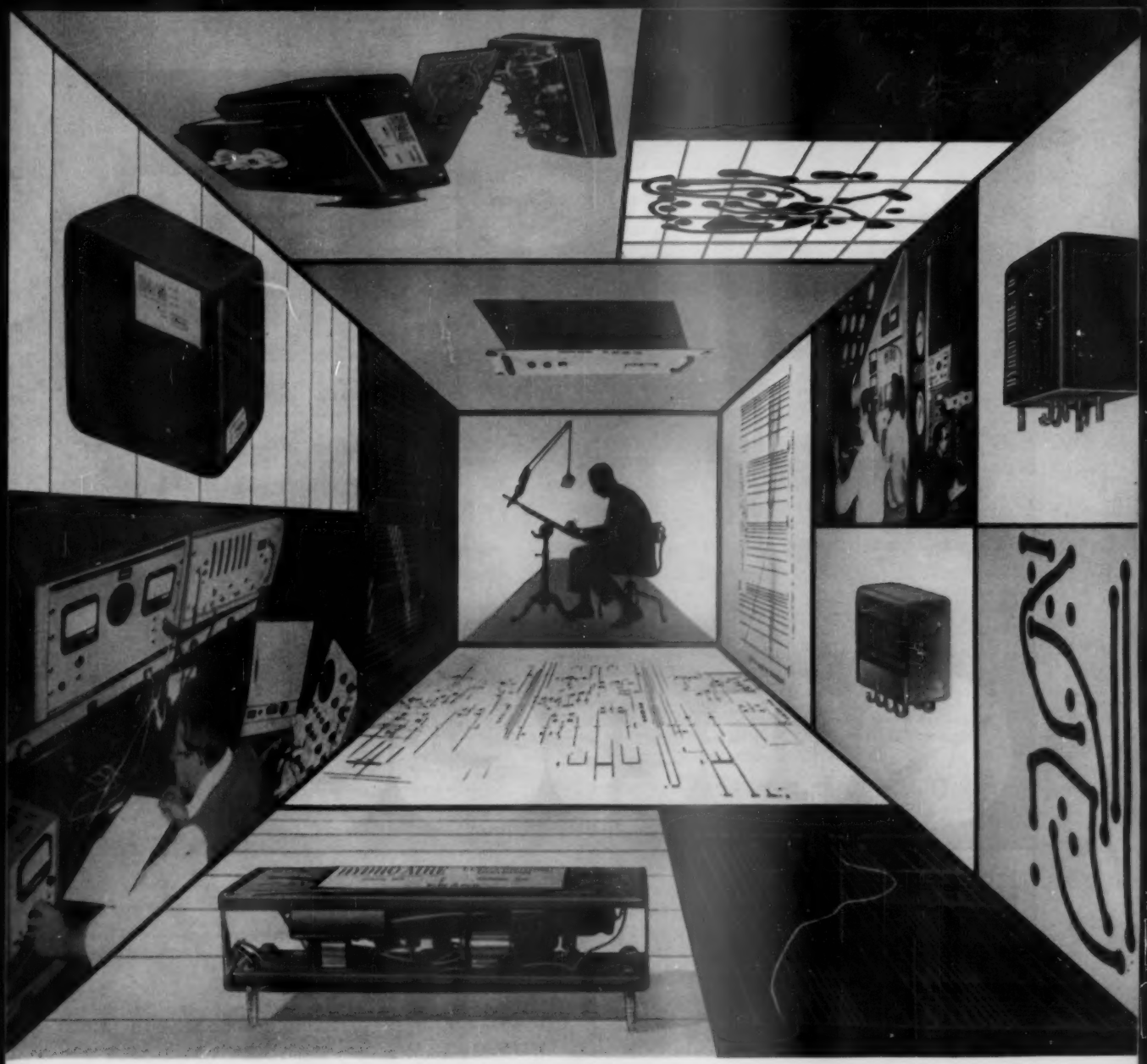
Engineers, scientists — investigate outstanding opportunities at Aerojet.



Solid State Components from Hydro-Aire may Solve Your Electronic Systems Problem

Today, Hydro-Aire offers you special skills in the development of solid state components to help you solve your systems problems. The Hydro-Aire Electronics Division has been created, staffed and tooled to provide flexibility in design, on-time delivery and reliable performance. These capabilities are now producing precise answers for project engineers at Martin, Boeing, Space Technology Laboratories, General Electric, Litton Industries, Magnavox, Autonetics, and many others.

For a prompt answer to your inquiry, write Electronics Division, Hydro-Aire, 3000 Winona Avenue, Burbank. A note on your letterhead brings your copy of our new Electronics Brochure.

Qualified Electronics Engineers are invited to investigate opportunities at Hydro-Aire by contacting Mr. Harold Giesecke.

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Solid-state devices include time delay devices, voltage regulators, power supplies, inverters.

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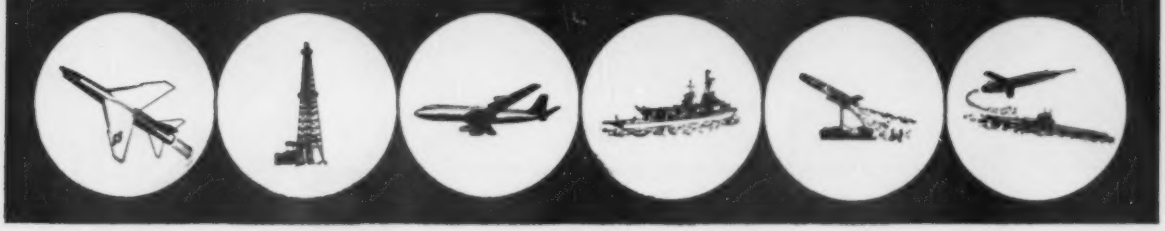

With 38 years acceptance Sargent builds precision linear and rotary hydraulic, pneumatic, mechanical and electronic systems of force control to meet successfully the increasingly high requirements of marine, aircraft, missile, petroleum and industrial use. From original idea to finished product – SARGENT.

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"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

May 23-25—12th Annual Meeting, German Society for Rocket Engineering and Space Flight Research, Heidelberg, Germany.

May 23-25—1960 National Telemetering Conference, Miramar Hotel, Santa Monica, Calif. Sponsors: Instrument Society of America; American Rocket Society; American Institute of Electrical Engineers; Institute of the Aeronautical Sciences; Institute of Radio Engineers.

May 23-25—14th Annual Armed Forces Communication and Electronics Assn. Convention, Sheraton Park Hotel, Washington, D. C.

May 24-26—1960 Convention, American Society for Quality Control, San Francisco, Calif.

May 25-27—National Specialists Meeting on Guidance of Aerospace Vehicles, Institute of the Aeronautical Sciences, Hotel Somerset, Boston, Mass.

May 26-27—"Psychophysiological Aspects of Space Flight," symposium, Hilton Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine, USAF Aerospace Medical Center (ATC), and arranged by Southwest Research Institute. Unclassified, but by invitation.

May 27-30—12th Annual Wright Memorial Glider Meet. For information: Soaring Society of Dayton, Inc., Far Hills Branch, P. O. Box 581, Dayton 19, Ohio.

June 3-4—11th National Maintenance & Operations Meeting, Reading Aviation Service, Reading, Pa.

June 5-9—Semi-Annual Meeting and Aviation Conference, American Society of Mechanical Engineers, Statler Hilton Hotel, Dallas, Tex.

June 14-16—35th Meeting, Aviation Distributors and Manufacturers Assn., Queen Elizabeth Hotel, Montreal, Canada.

June 15-17—1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, Stanford, Calif.

(Continued on page 6)

AVIATION WEEK and Space Technology

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Vol. 72, No. 20

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Engineering notes from the **SM/I REPORTER**

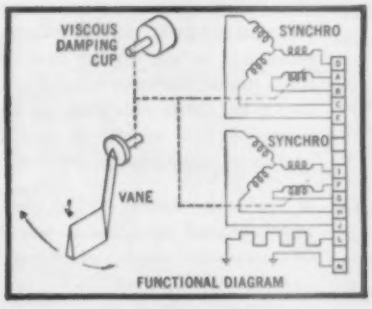
BY STANLEY M. INGERSOLL, *Capabilities Engineer*

Report No. 5
TR 722-2 Angle of Attack Transmitter

Precision built and self-powered, the TR 722-2 provides an electrical output proportional to the direction of local airflow surrounding an aircraft. It may be used to transmit local angle of attack or yaw, and its output signal can be applied directly to a visual indicator. The TR 722-2 is ideal for use on all types of military jet aircraft because of its accuracy, inherent stability, compact packaging and rugged design. The vane air foil used is drag stabilized and has passed rigid military qualification programs. The TR 722-2 has been qualified by Wright Air Development Center and is listed on Qualified Parts Lists under MS24378. The unit meets or exceeds MIL-T-25627 and amendments.

Typical Performance Specifications

Electrical Output	Two Synchro Transmitters
Electrical Angle	135°
Mechanical Angle	50°
Sensitivity:	
90 to 125 knots	0.2°
125 knots to Mach 4.37	0.1°
Power Requirements	115V at 400 Cycles 26V at 400 Cycles
Heater	115V
135 Watts Max. at	30°C.
Electrical Output Error	±0.2°
Temperature Range	−54°C. to +93°C.
Damping	0.75 Critical at 110 knots
Weight	1.8 lbs. max.



TR 722-2 Angle of Attack Transmitter

For more information and complete operating specifications, write or wire SM/I today. Address your inquiry to Stanley M. Ingersoll, Capabilities Engineer.

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AIRBORNE ACTUATOR SPECIFIED FOR RELIABLE CONTROL OF LOX VALVE

Atlas LOX fill-and-drain valve employs Airborne Model L16-37 actuator to control butterfly shut-off. High efficiency of actuator, plus use of trunnion mounting, results in an extremely compact, weight-saving package.

You will find Airborne electromechanical actuators in the componentry of a number of operational missiles and space vehicles. And for good reason. Their reputation for quality and their record of reliability – not only on missiles but also on many famous aircraft – are outstanding.

In the application shown it is the actuator's function to rotate an off-center butterfly shutoff in a liquid oxygen valve designed for the Atlas ICBM by Fairchild's Stratos Division. Reliability requirements are high, particularly in view of the temperature extremes and heavy "g" forces imposed by the operating environment. And the function of holding the shutoff closed is critical, because the liquid oxygen tanks require pressurization at all times to structurally support them.

Also vitally important in designing the missile-borne portion of the valve was weight. In the case of the actuator, Airborne held weight to 3.6 lb., while providing for an operating load of 600 lb. and a maximum static load of 2000 lb.

If you have requirements in electromechanical actuation – linear or rotary – for missiles or aircraft, contact any of our offices for further information or proposals. Or write for new Catalog GC-60.

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AVIATION CALENDAR

(Continued from page 5)

June 22-24—1960 Conference on Standards and Electronic Measurements, NBS Boulder Laboratories, Boulder, Colo. Co-sponsors: Institute of Radio Engineers' Professional Group on Instrumentation; Radio Standards Laboratory, National Bureau of Standards; American Institute of Electrical Engineers' Instrumentation Division.

June 23-25—16th Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.

June 26-July 1—63rd Annual Meeting and Apparatus Exhibit, American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 27-29—Fourth National Convention on Military Electronics, Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

June 28-July 1—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

July 3-4—Fourth Annual Fort Wayne National Championships (civilian, closed-course airplane races), Fort Wayne, Ind.

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 28-29—Seventh Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

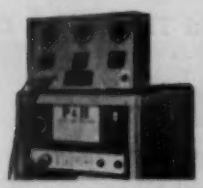
Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 27-30—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif. Cosponsors: USAF; U.S. Army; U.S. Navy; National Aeronautics and Space Administration; Atomic Energy Commission.

P&H TAPE-PROGRAMMING completely automates the fusion process and is far superior to human control. Additional channels on tape and reader provide precise control for rotation, wire-feed, gas and water flow, and other related functions.

P&H MOTORIZED RHEOSTAT permits pre-setting of up-slope, welding cycle, and decay at intervals of 6 to 50 seconds—and controls them at exact values. Weld time can be pre-set or controlled manually.



P&H AUTOMATIC SPOT-GUN CONTROL enables operator to pre-set time interval and heat for starting, welding, finishing, and post-flow of gas and water in spot-gun welding. "Add-on" units for existing welders — integral in new machines.

Now... programmed welding automation from P&H!

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Another modern development is the new P&H punched-tape control for production welding. This industry "first" enables you to tape your jobs today — and weld tomorrow or next month. You can handle more work and get the same top-quality welds regardless of who operates the unit.

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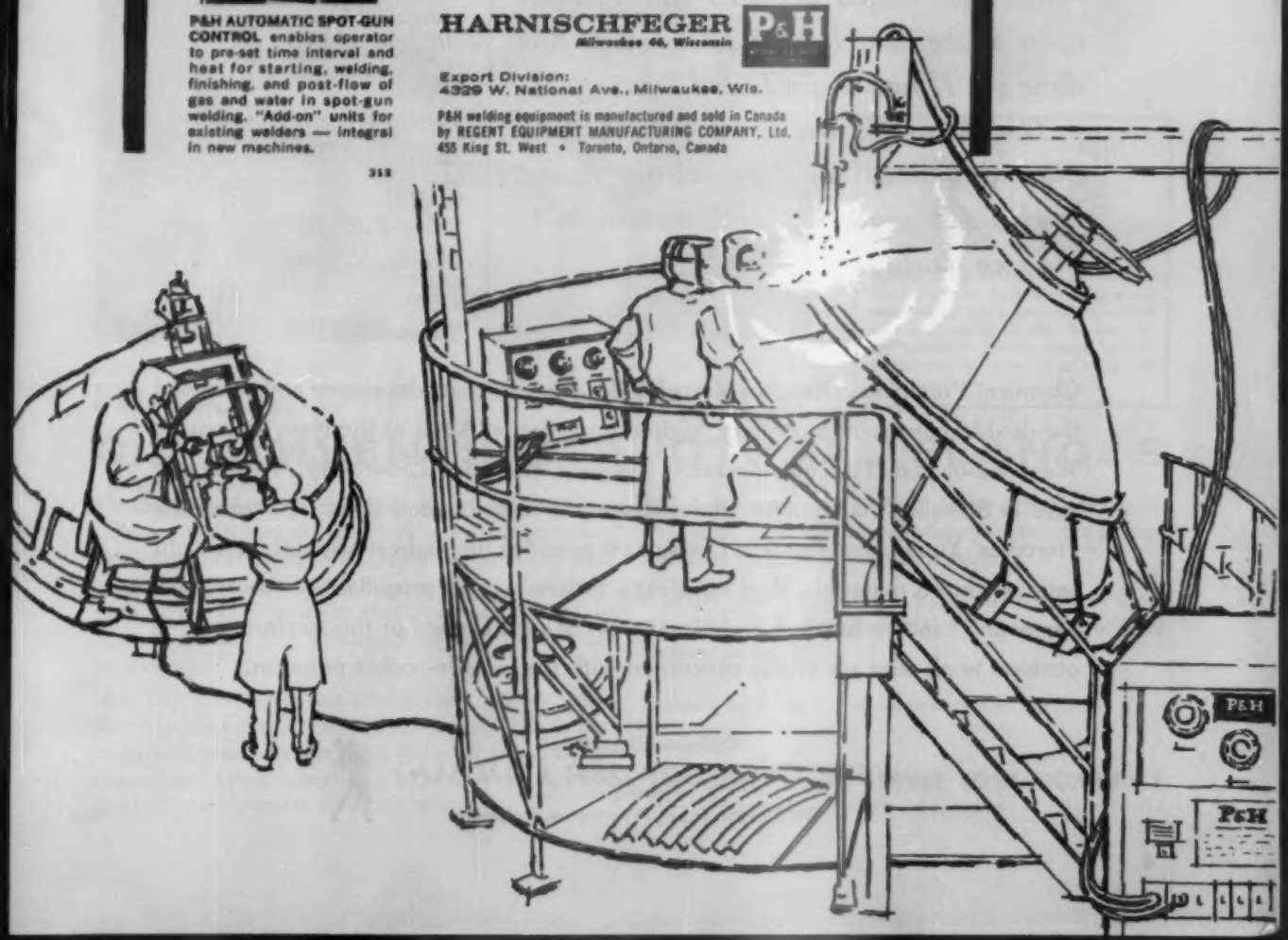


A report from Hercules Powder Company on the performance of ALTAIR

The X248—named by NASA the Altair —has been called upon 13 times to put up a space vehicle and 13 times it has done so. It has never failed.

The Altair is the most reliable and most advanced solid propellant rocket engine for space research available to the free world.

HERE IS THE SCORE CARD:

★ ★ ★

Pioneer I, (Lunar Probe)
Javelin I
Explorer VI, "Paddlewheel"
Vanguard III
"Shot-Put" I
Argo I
Javelin III
"Shot-Put" II
Argo II
"Shot-Put" III
Pioneer V
Tiros
"Shot-Put" IV

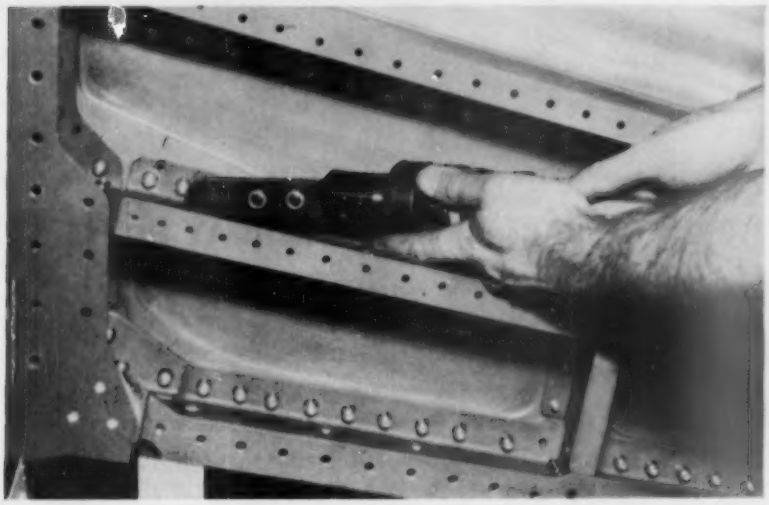
Chemical Propulsion Division, Hercules Powder Company developed and produced the double-base solid propellant, high altitude rocket Altair at the Navy Bureau of Weapons-owned, Hercules-operated Allegany Ballistics Laboratory. The engine case is Spiralloy® continuous filament-wound, resin-bonded glass fiber made by Hercules' Young Development Division; it provides the highest strength-to-weight ratio of known materials, thus enabling a greater weight propellant or "more push per pound" in the finished rocket motor. The significance of this performance is obvious to all who are vitally concerned with the missile-rocket program.

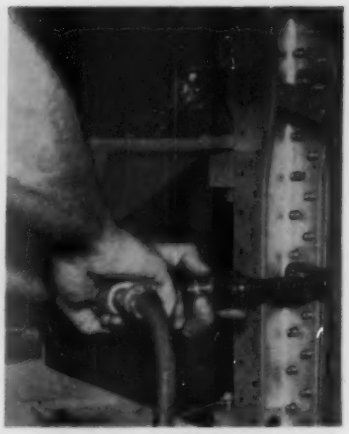
Explosives Department
HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington, Delaware

XP60-1

Upper photo: Hi-Loks fasten the entire lower skin panel to ribs and beams.

Lower photo: Modified 20° attachment tool on Keller Air Driver installs Hi-Loks on beam flanges. The Hi-Lok installation is quiet and eliminates the progressive pounding to the structure normally associated with the installation of swage type fasteners using pneumatic hammers.





Hi-Lok 2" offset extended adaptor fitted to an Ingersoll-Rand Air Motor reduces a 2-man, 32-hour assembly job on the landing gear steel support rib to a one-man, 4-hour job. Additionally, the change to Hi-Loks reduced the installed fastener rejection rate from 30% to practically nil.

hi-Lok®
FASTENER
CUTS 32
HOUR JOB
TO 4

CONTROLLED PRELOAD...the torque-off feature of the Hi-Lok collar *automatically* gives a preload condition *consistent within* ±10%. Because of the torque-off feature, torque wrench inspection after installation is not required.

HI-LOK OFFSET TOOLING CIRCUMVENTS STRUCTURAL FLANGES

The change to high strength Hi-Lok Fasteners and Hi-Lok tooling on the Northrop T-38 Talon supersonic jet trainer, overcame acute accessibility problems caused by wide flanges on structural ribs and beams in the thin, single panel wing. The switch to Hi-Loks from swage type fasteners resulted in a substantial savings in installation manhours.

More than a 50% tool cost savings alone was realized at Northrop when swage fastener tooling, with its single purpose power units, squeezer yokes and other special tooling was replaced with simple Hi-Lok offset tooling adapted to standard, multi-purpose air driver motors.

Installation rates up to 45 Hi-Loks per minute are obtainable using automatic drivers where the structure is open and when speed of installation is essential.

Contact your Engineering Standards Group or write directly to us for additional data on Hi-Loks and our other fastener products.

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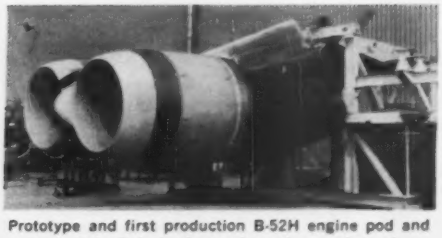
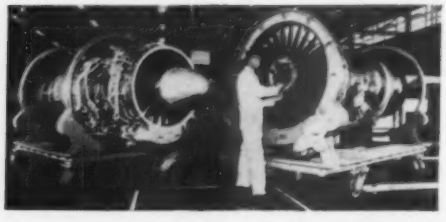


Prototype and first production B-52H engine pod and pylon built by Rohr is shown above. Lower photo shows external appearance and size comparison between turbofan engine that will power the new eight-jet Boeing B-52H missile bombers, right, and the turbojet currently used on the B-52G, left.



FOR SACs NEWEST "SUNDAY PUNCH"

Within a year, the Boeing Airplane Company in Wichita will begin rolling out the newest version of its distinguished Stratofortress, the B-52H. Rohr, an active participant in the B-52 program from its beginning nearly a decade ago, is producing jet pods for the "H".

The mighty B-52 has earned its role as an enduring workhorse of the Strategic Air Command. No longer considered just a bomber, it has been dubbed a "launching pad in the sky" by its makers.

Within the Rohr-built twin pods of the B-52H will be eight Pratt & Whitney turbofan engines, providing about 50 per cent more takeoff thrust, 25 per cent more climbing power, and 20 per cent greater cruise power than its predecessors.

With a range of well over 9,000 miles and an arsenal of devastating missiles, the "H" will be an awesome deterrent to aggression, and a lasting weapon for peace.

Rohr is proud of its contributions to the aerospace industry, both military and commercial . . . contributions which have made Rohr the world's largest producer of components for flight.

ROHR
AIRCRAFT CORPORATION

World's Largest Producer of Components for Flight
Main Plant and Headquarters: Chula Vista, Calif.
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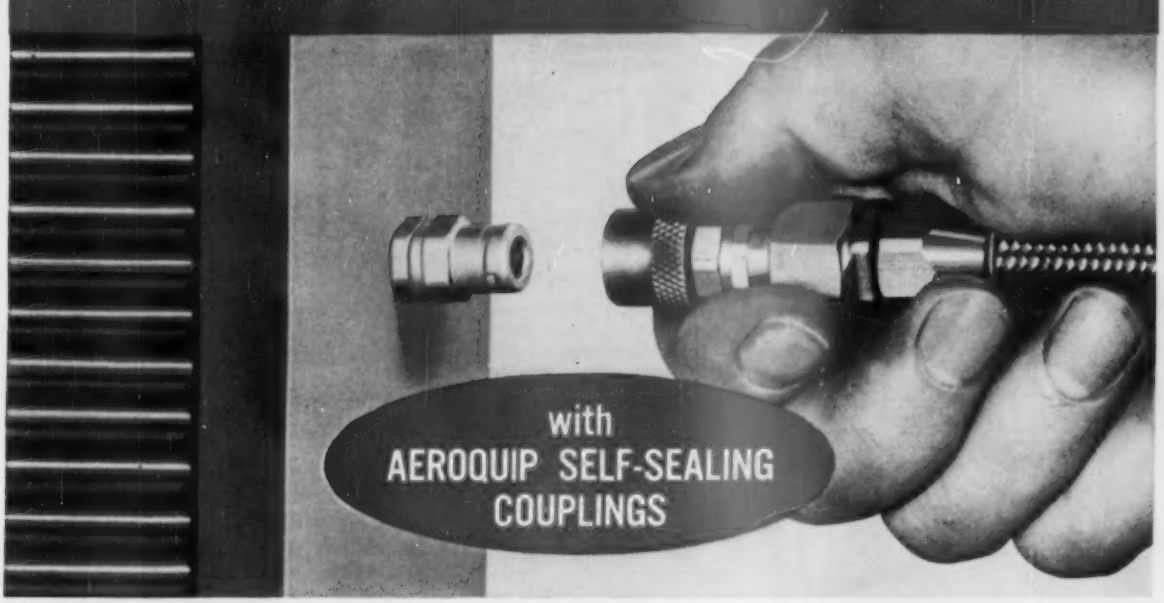
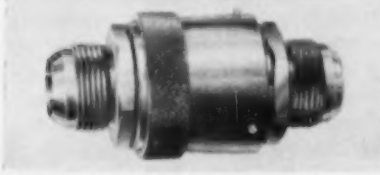
CONNECT AND DISCONNECT ELECTRONIC COOLANT SYSTEM LINES



Now, you can connect and disconnect coolant lines on electronic equipment in seconds, using Aeroquip Self-Sealing Couplings. Aeroquip offers a range of quick-disconnect couplings to meet requirements of all airborne and ground support electronic systems. Types include miniaturized couplings for compact airborne systems (the miniaturized coupling pictured above weighs only .037 lbs.) as well as standard sizes through 1½". Operating features of Aeroquip Couplings include high flow rates and a variety of connection and disconnection methods, with little or no fluid loss.

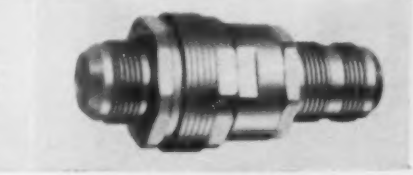
Aeroquip's engineering staff, the largest and most complete in its field, has developed literally hundreds of specialized quick-disconnect couplings. If you have a fluid line connection or disconnection problem, Aeroquip's unmatched experience and resources are at your service.

Fill in and mail the coupon below for information and engineering assistance.



3750 Series SAF-LOC Coupling for ¼" to 1½" lines features visual lock indicator pins for foolproof connection. Full flow design with low pressure drop. SAF-LOC is an Aeroquip trademark.

1010 Series Miniaturized Coupling for airborne electronic systems. Lightweight (.037 lbs.) and compact envelope design permits use in confined space. For ¼" O.D. tube size lines.



3900 Series PUSH-PULL Couplings offer very low pressure drop, and ease of connection and disconnection with no fluid loss in a wide range of sizes. Designed for low lubricity fluids such as FC-75.

EXAMPLES OF UNLIMITED COUPLING DESIGNS BY

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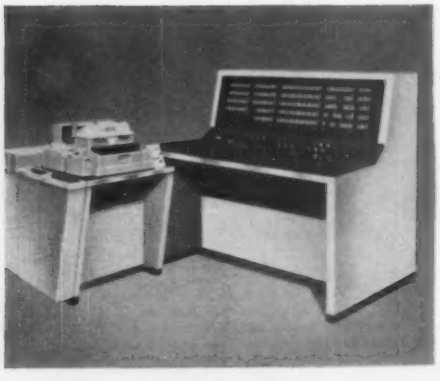
The Univac Scientific computer is used to simulate and prove the projected design of new systems. This concept of mechanized design, which may be described as the use of one computer to build another, eliminates prototype building and attains a degree of reliability once regarded as only theoretically possible.

A technician follows the wiring diagram produced by the Univac Scientific. This application of mechanized design greatly facilitates the production of reliable automatic data processing equipment.



A significant achievement of mechanized design is the **BOGART** computer, produced by Remington Rand Univac, for the U.S. Navy. Intensive preliminary testing of the projected system made it possible to reduce the size of the computer while materially increasing its reliability through the use of transistors and printed circuitry.

From the REMINGTON RAND UNIVAC

Military Division

Mechanized Design Dramatically Speeds Development and Increases the Reliability of New Data Processing Systems

Remington Rand Univac was the first to apply the concept of mechanized design to computer development. By using the Univac Scientific computer, the design of a projected system can be fully simulated and proved—thus avoiding the expensive, time-consuming process of prototype building.

This important technique has already made indispensable contributions to the development of such systems as the Univac LARC and Athena and the Univac Advanced Navy computer. Mechanized design has significantly aided Univac scientists and engineers in attaining the farthest limits of reliability, even under the most demanding environmental conditions.

The Military Division's tradition of excellence is firmly established by a distinguished series of defense systems. Mechanized design is another example of the outstanding capabilities which Remington Rand Univac can bring to bear on the development and production of complex computer equipment for military applications.

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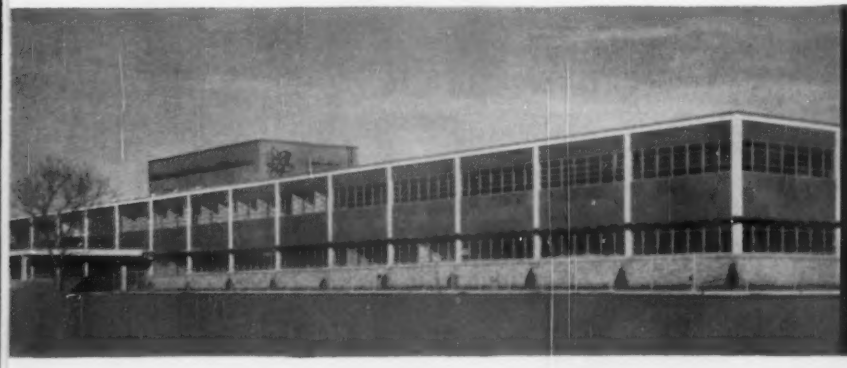

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SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY

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AERO PRODUCTS, INC.
PUTS A DAMPER ON AIRCRAFT HAZARDS!

A – Rudder — 4 Flutter Dampers — 2 Tab Dampers.
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CLEMCO AERO PRODUCTS tab and flutter dampers are used on the CONVAIR 600 and 880.

TAB DAMPERS

The Clemco Aero Products Tab Damper is used on the flying tabs of the world's fastest commercial jet liners where it serves the important function of flutter prevention.

The important requirements of this application are low static friction, a linear damping constant, zero lost motion and relatively high dynamic stiffness. All of these requirements must be met through a temperature range of +160°F. to –65°F.

The Clemco Aero Products design meets these requirements with a rotary hydraulic damper with a self-contained accumulator and thermal compensation.

Specifications are as follows:

Maximum static friction 1.5 inch-lbs. at –65°F.

Damping constant up to 150 inch-lb./rad/second.

Travel ±40°.

Limit load 660 inch-lbs.

Dynamic stiffness 52,000 inch-lbs./rad.

Fluid MIL-H-5606

Weight 2.77 lbs.

Coupling Provision ½" diameter involute serration Per NAS542-64-31.

The damper has undergone more than a million cycles of oscillation at ±½° amplitude, at a rate of 25 CPS, and extensive thermal cycling with no evidence of deterioration.

The characteristics of low static friction, low inertia, high dynamic stiffness and linear damping, obtainable in this basic design, suggest its use in many applications where mathematically idealized viscous damping is desirable.

Designs to meet your specific application will be supplied on request.

FLUTTER DAMPERS

The Clemco Aero Products Rotary Flutter Damper is used on the control surfaces of the world's fastest jet airliners as well as on many high performance military aircraft.

The primary advantages are space conservations, low static friction and maximum overall system rigidity per pound of structural weight.

Space conservation is achieved by hinge line installations. Low static friction is a necessity for proper operation of a control system and is achieved by having the friction of the dynamic seals acting on a moment arm of approximately one-half inch.

Maximum system rigidity is attained by spanning a minimum amount of structure between the damper terminals. Since energy dissipation is limited by system rigidity, great savings in structural weight can be achieved by the use of rotary dampers.

The Clemco Aero Products Flutter Damper is a self-contained, temperature compensated, rotary hydraulic damper with integral shaft and housing vanes, and a visual fluid level indicator.

Three basic sizes are now in production and have been fully qualified.

Dia.	*Max. Damping Constant in in-lb/rad/sec.*	*Dynamic Stiffness in-lb/rad.*	*Angular Travel*	*Coupling Serration Diameter*
1.50	550	163,000	±30°	.875
1.75	1,400	235,000	±35°	1.00
2.00-1	2,000	345,000	±35°	1⅛
2.00-2	1,200	300,000	±47.5°	1⅛

All maximum damping constants are at +160°F., and can be increased if desired at lower temperatures. The length of all units is approximately 7" and the static friction approximately 6 inch-lbs.

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GOODYEAR

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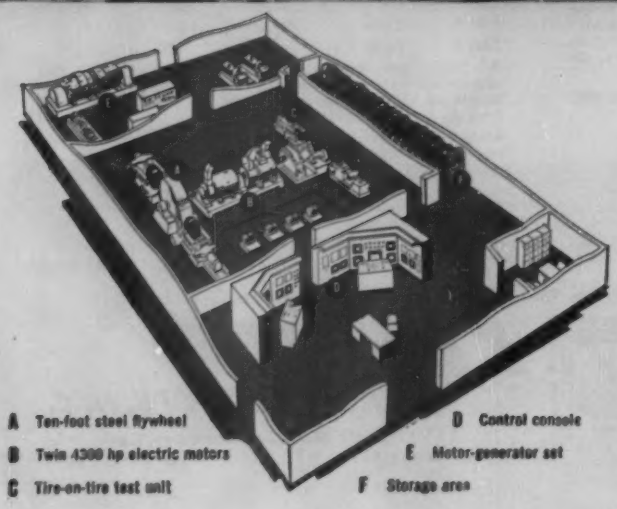

A Ten-foot steel flywheel
B Twin 4300 hp electric motors
C Tire-on-tire test unit
D Control console
E Motor-generator set
F Storage area

320-mph "runway" highlights new $2-million test facility to create 1970's tires today

Housed in a 9375-sq.-ft. building specially designed to accommodate the most advanced concepts in dynamometer technology, Goodyear's giant new test-wheel is spun at record-breaking speed by two electric motors delivering 8600 hp with maximum torque of 50,000 lbs.-ft. They spin a tire under rated load from standstill to 300 mph in only 18 seconds!

Simulated takeoff and taxi loads of over 80,000 lbs. can be imposed on tires 16 inches to six feet in diameter.

Opposite end of motor shaft drives unique "tire-on-tire" test unit which appraises new materials, designs and constructions at top speed of over 500 mph!

All four test units of the machine can also be operated independently at any desired load or speed. Tires can be preheated to 800°F to simulate effect of supersonic flight. Yaw and camber up to 15° can be provided as well.

Precise control of all operations is afforded by complex electronic instrumentation, both automatic and manual. Electronic programmer, following taped instructions, programs tests which are recorded and monitored via closed-circuit television for safety.

rolls tire-testing 10 years ahead...in 18 seconds!

Goodyear's new $2-million dynamometer system qualifies aviation tires up to 320 mph... advances research frontier to 500 mph...accelerates from 0 to 300 mph in 18 seconds... simulates all tire operating conditions...meets all test demands in view till 1970!

Next time you watch a 20-ton Mach 2 jet screaming off a runway at over 250 mph–or a huge 150-ton jetliner gracefully settling in at nearly 150 – recall this fact: The fate of precious lives and multimillion-dollar planes rides on the stamina of their tires – *and basically they're only rubber and fabric!*

The Race to Keep Pace

Few years ago, building an aircraft tire, while demanding enough, did not stretch to the limit an engineer's competence, the endurance of rubber and fabric, or the capacity of current testing facilities. (And *50* years ago, when Goodyear built the *first* airplane tire, replacing runners used by the Wright brothers, the tire barely got warm on the job!)

Suddenly, however, the Jet Age turned on the heat. Landing speeds jumped from 120 mph in 1945 to 200 mph in '55– with 300 mph coming up. (At 250 mph a tire can flex *12,000 to 16,000 times a minute!*) Pressures zoomed, too– from the 1945 level of 120 psi to 400 psi today. (Potential energy in a B-52 tire under load could theoretically drive a golf ball into orbit!) Planes put on weight at a frightening rate–today each pound of tire must carry nearly *400* pounds of airplane! Yet tire size is strictly limited by available stowage space in the plane.

Goodyear engineering talent kept up with the scorching pace, to be sure. For the most part, so did materials, although we're constantly experimenting with new types. Far down the runway, however, were the industry's test facilities essential to design, development and qualifying new tires. None was equal to the job of *accurately* duplicating high-speed landings; none could simulate takeoffs or taxiing

No Ceiling on Specs

But the job got done. Even though new specifications regularly kept breaking through "unbreakable" ceilings, Goodyear consistently came up with major advances to exceed the ever-stiffer specifications. Some examples:

First tubeless tires specified for commercial airliners

First low profile tires to meet USAF high-speed specifications

First sidewall-inflation airplane tire

Still, merely meeting specifications is not the way Goodyear built its commanding lead in tire manufacturing. And it was all too clear that designers were busy drawing up even tougher jobs for aircraft tires during the decade to come. So, with an eye on 1970, Goodyear recently launched a two-part crash program. Its goals:

1. *Establish* a never-before-achieved level of quality control to assure that every Goodyear tire incorporates only the highest-grade materials, is manufactured to the highest standards. This program is now in effect. Its cost is high – but the price of perfection was never low.
2. *Develop* the industry's most advanced testing facilities, capable of evaluating tires for high-performance aircraft of today, tomorrow–and the foreseeable future! The $2-million multistage dynamometer you see on the facing page is the answer–Goodyear's answer to the pressing needs of defense.

Goodyear Funds the Future

Today Goodyear–alone in the tire industry–is fully prepared to produce the tires our nation's military and commercial aircraft will need in the critical years ahead. And the substantial investment represented by Goodyear's unprecedented quality-control program and advanced test facilities is renewed evidence of this company's faith in aviation as the backbone of future world transport.

For detailed information on these latest achievements in Goodyear's 50-year record of service to the aviation industry and the more than 500 different airplane tires manufactured by Goodyear, write on company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. Q-1715, Akron 16, Ohio.

Lots of good things come from

GOODYEAR

More aircraft land on Goodyear tires, wheels and brakes than on any other kind

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PTER CORP.

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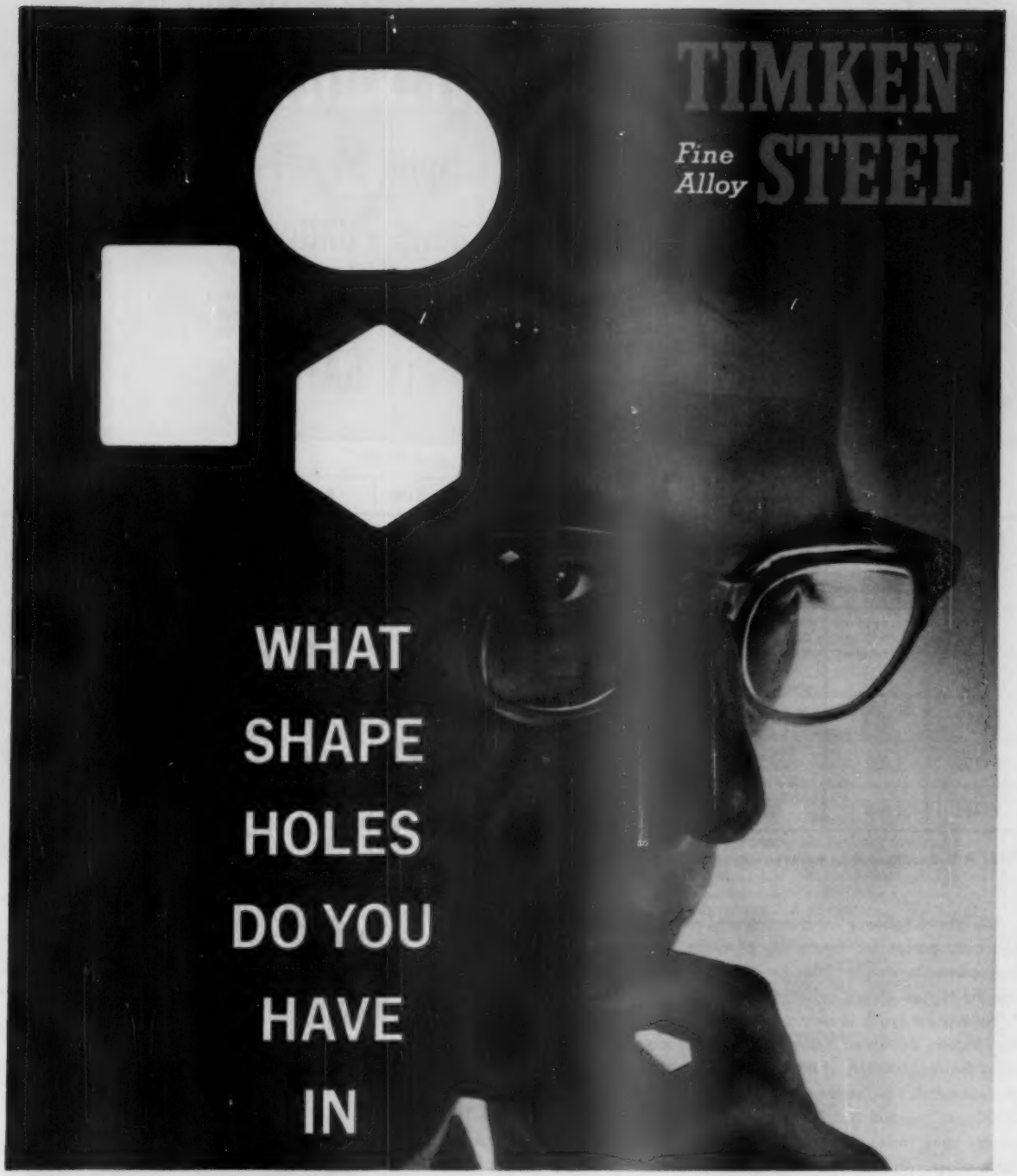
... in its 25th year



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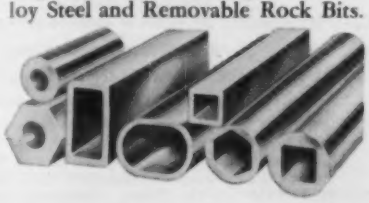


BEING INTEGRATED INTO TOMORROW'S AIRCRAFT AND MISSILE SYSTEMS

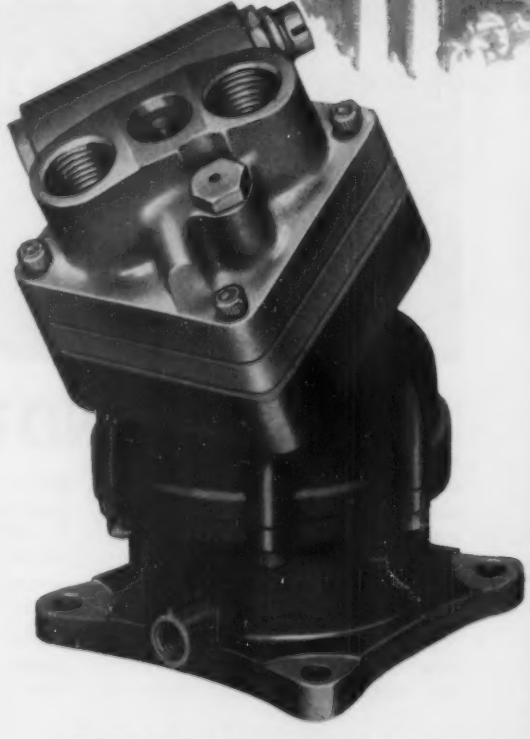
NEW VICKERS Variable Displacement Hydraulic Pumps with MAXIMUM HP/LB RATIO

Model Series	Displacement cu. in./rev.	RPM		Weight lb.	HP/LB*	
		Limited Life	Rated		Limited Life	Rated
PV006	.095	18,200	12,500	2.8	4.55	3.12
PV012	.188	14,500	10,000	4.5	4.45	3.06
PV024	.367	11,600	8,000	6.9	4.53	3.13
PV039	.600	10,000	8,000	10.2	4.33	3.46
PV062	.950	8,900	7,000	14.0	4.44	3.49
PV104	1.600	7,500	5,800	19.0	4.65	3.59
PV163	2.500	6,500	5,100	26.0	4.60	3.60

***This is hydraulic output horsepower at 3000 psi**

The above table is important to anyone concerned with the selection of hydraulic pumps for future air or space vehicles. Note particularly the horsepower-to-weight ratios for both rated and limited life speeds. These are the highest known available at this time.

But highest hp/lb is only one of many advantages offered you by the new Vickers advanced design variable displacement pumps. Developed to meet the requirements of the new MIL-P-19692 specification, this new series has volumetric efficiencies of 96% to 98% over a pressure range of 500 to 3000 psi . . . and has 4000 psi continuous operation capabilities. These pumps have faster response and improved contamination resistance; they have practically the same envelope as constant displacement units of equal output. The first five sizes are now being integrated into advanced aircraft and missile systems; the two larger sizes are in the development stage. Write for Bulletin A-5233 for additional information.



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U. S. to Continue U-2 Flights Over Soviet 26
▶ 'Rocket' boasts of Russians largely discounted; loss of plane attributed to flameout of engine.

Airlines Protest FAA Recorder Ruling 38
▶ ATA battles proposal on grounds expense will not justify the 'slight benefits' to investigations.

Component Reliability Practices Proposed 53
▶ Joint Defense Department-industry study is aimed at improving component quality, cutting development times.

SPACE TECHNOLOGY

Space Pilot Capabilities 66
Pioneer V Data Transmission 34
Mercury Capsule Flight Test 37
Aeronutronic Lunar Vehicle 69
Saturn Engine Static Firing 73
Tiros Orbital Heating 75
Deep-Space Tracking Facility 83

MISSILE ENGINEERING

Titan Second Stage Ignition 36
USAF Plan For STL 36
Army Weapon Demonstration 84
Navy Project Hydra 87

AERONAUTICAL ENGINEERING

U-2 Flights to Be Continued 26
Brantly B-2 Pilot Report 111
Extreme Cleanness Marks U-2 28
Bell HU-1A Production 132
New Morane-Saulnier Jet 35
Soviets Exploit U-2 30
Ike Approves U-2 Missions 32
U-2 Operational Chronology 33
Production Briefing 123

EQUIPMENT

Cargo Packs for Jets 138
USAF Adapts Cartridge Starter 142
New Aviation Products 144
What's New 145

AIR TRANSPORT

FAA Recorder Ruling 38
MATS Procurement Plan 39
Lockheed Completes Electra Test 40
FAA Idlewild Jet Noise Rules 41
TWA 707 Damaged in Landing 41
Eastern Interested in Boeing 727 43
Britannia Crash Cause Undetermined 45
Caravelle Versions Include Fan Engines 51
Shortlines 47
Airline Observer 47

MANAGEMENT

Procurement Changes Asked 125
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 37

FINANCIAL

United Plans 1963-65 Jet Orders 91
Aerospace Firms List Salaries 102
Airlines List Officers' Salaries 105
Lockheed Stock Dividend 95
Acquisitions & Mergers 98
Financial Briefs 98
New Offerings 99

AVIONICS

Component Reliability Practices 53
Micromodule Environmental Tests 59
Filter Center 64
New Avionic Products 64

Calendar 5
Letters 158

EDITORIAL

U-2 Over Sverdlovsk; Fact and Fiction .. 20

COVER: Tiros I satellite's wide-angle camera lens photographed this section of earth, showing the Nile (left) and the Red Sea (center), and relayed the image to earth. Note earth's curvature at upper left.

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EDITORIAL

Lockheed U-2 Over Sverdlovsk:

The whole truth of Francis Gary Powers' 1,400-mi. penetration of the Soviet Union in a Lockheed U-2 on a Central Intelligence Agency mission of photo and electronic reconnaissance has not yet been told. It may never emerge from the welter of official lies pouring from Moscow and Washington.

Nevertheless, there are some points that have already emerged from this adventure that are worth examining. Let us start with the fabrications that have been bull-roared from the rostrum of the Supreme Soviet by Nikita Khrushchev because they reveal much about his fears and problems over the current state of the world.

Mr. Khrushchev's most blatant lie is his statement that the U-2 was hit by a Red Army anti-aircraft missile at an altitude of 65,000 ft. near Sverdlovsk after it had penetrated the air defenses of the Soviet Union for some 1,400 mi. This lie was necessary because the citizens of the USSR could understandably grow uneasy over the admitted ability of the U-2 and other specialized aircraft to penetrate Soviet airspace consistently with impunity. The spectacle of Soviet air defense system futility for the last four years in trying to stop these penetrations must provide a chilling counterpoint for Soviet citizens to the bellicose blustering of their leader over the aggressive strength of his military power.

The fact is, and Mr. Khrushchev undoubtedly knows it, that Powers' U-2 had an engine flameout at the altitude that it and other U-2 aircraft cruised safely beyond the reach of the Soviet air defense system. The flameout forced Powers to descend below 40,000 ft. where the denser atmosphere made an attempt to restart his jet engine feasible. Either Power failed to restart his engine or his plane was damaged at this relatively low altitude by the Red Army missile men to whom Mr. Khrushchev awarded medals.

Another obvious lie was used to bolster this originally false claim for the Soviet air defense system. A picture of some badly battered scrap from an Aeroflot Tu-104 crash near Sverdlovsk last February was officially released by the Soviets labeled as the U-2 wreckage to convey an impression of terrible damage wrought by the anti-aircraft missile. When this fake was exposed by Lockheed's U-2 designer, C. L. "Kelly" Johnson, the remains of the genuine U-2 were finally produced for an exhibition in Moscow's Gorki Park.

Further contradiction of the missile hit scored at 65,000 ft. was the Soviets' own claim that they recovered most of the U-2 photo and electronic reconnaissance equipment in good condition, were able to examine the cockpit ejection system in detail and to retrieve miscellaneous gear from the cockpit intact.

Mr. Khrushchev has good reason to worry about the ability of the U-2 and other aircraft to skim over his huge air defense system. For it must come as a real shocker to Soviet citizens, fed a steady diet of propaganda on the superiority of Soviet military might, to hear the admissions from Mr. Khrushchev and Andrei Gromyko that these U-2 flights have been going on successfully for at least four years. The Soviet citizens must wonder, if this is true, how much credence they can place in the assurances they receive from Mr. Khrushchev that manned bombers are obsolete and cannot penetrate the Soviet air defense system. Even if his claim of a missile hit at Sverdlovsk was true, how does Mr. Khrushchev explain a 1,400-mi. penetration from the Pakistan border to the Urals?

It is obvious that Mr. Khrushchev does not really believe his own claims about the difficulty of manned bomber penetration into the USSR because he has been pushing a gigantic expansion of his air defense system for the past several years. This includes new improved surveillance, and ground control intercept radar, passive detection systems, new interceptors and a tremendous program of new anti-aircraft missile installations around key military and industrial areas. If Mr. Khrushchev really believed the Strategic Air Command B-47, B-52 and B-58 fleet of manned bombers were as ineffective as he publicly blusters, he would hardly waste the vast resources that he has and is still putting into his air defense system.

Nor is Mr. Khrushchev telling the truth when he announces that the Soviets have switched completely from bombers to ballistic missiles and that they no longer are producing or developing or exercising bombers because they are obsolete for modern warfare. The USSR is still producing long range jet bombers, although at far from maximum possible rates. It is developing new supersonic bombers and a nuclear-powered bomber and it is exercising its current operational jet bomber fleet at an accelerated rate in long distance Arctic missions. Mr. Khrushchev would like us to believe his lies on the future of the bomber in the Soviet arsenal. This belief would encourage the trend, already started, toward cutting back our own air defense system.

Mr. Khrushchev is also ignoring some pertinent facts when he stresses the "provocative" nature of the U-2 flights. The Soviet espionage system in this country has been exposed in many aspects of its hydra-headed operation. The record from the atomic secret snitching of Klaus Fuchs to the cozy Brooklyn espionage nest operated by the Soviet Col. Abel has offered ample provocation for anything this country cares to make of it.

The Soviets are fighting the reconnaissance war with every method at their disposal all around the periphery of the Iron Curtain, cutting transatlantic cables off Newfoundland, grappling for Caesar anti-submarine warfare stations, fishing for nose cones off Ascension Island, monitoring the Atlantic Missile Range communications, shadowing Polaris submarines and conducting electronic reconnaissance on our frontiers by trawler, submarine and aircraft. The Soviets do not require deep penetration of the United States for photo reconnaissance because of the availability of this information from public sources and their espionage system. Their prime need is for electronic intelligence and this they are gathering with every means at their disposal.

A Study in Fabrication

When we turn to the record of our own government agencies involved in the U-2 adventure the record of deliberate falsification is equally bad. The series of interagency bungles gives us a queasy feeling over what might happen in a real emergency with survival or defeat hinging on the speed and acumen of the official reaction.

First, there are the ivory tower researchers of the old NACA now with NASA who had their hard-won reputation for scientific integrity shredded overnight by the exposure of their role as unwitting dupes of the Central Intelligence Agency. They saw no reason to sniff suspiciously at an offer of a free research program for high altitude weather and gust loading research from the military. This bailment of military aircraft to NACA was traditional, since NACA had no budget of its own for this purpose. NACA wrote the test program requirements, sporadically got back data from missions executed according to its specifications and apparently never did much analytical research into the geographic locations of the U-2s or the isolation of the agency from any contact with their personnel. NACA, and later NASA, dutifully published three technical reports in four years on this work and worked happily in the traditional role of the piano player in a bagnio who was never told what was going on upstairs.

This coupling of CIA (which Washington wags are now saying stands for Caught in the Act) with NASA in an international espionage venture will badly damage, if not altogether destroy, the fine foundation NASA was organizing for international cooperation in the scientific exploration of space. NASA can hardly blame foreign nations already solicited in this program for inquiring as to how much of a tracking station, launching site or payload instrumentation is earmarked for CIA missions. Nor can they be blamed for politely declining to take a chance with an agency that apparently doesn't know all it should about its own activities.

This damage to NASA's scientific integrity may count for little in the calloused calculations of CIA supersleuths, but it will do irreparable harm in the international scientific community where this country has many of its staunchest friends.

Second is the spectacle of the State Department turning a complete slow motion somersault from the flat lie that "there was no deliberate attempt to violate the Soviet airspace and there never has been," to a mousy admission that there might have been such flights but that they "were not authorized by Washington," to a final complete admission that the U-2 penetrations were in fact an integral part of U.S. national policy. What the State Department can command as a credibility factor in future roles as a U.S. spokesman will be interesting to see.

The official U.S. policy as finally stated by President Eisenhower some 10 days after Powers' U-2 hit the Siberian earth also carries some future forebodings.

It officially commits the United States to a continuous and deliberate policy of violating the Soviet airspace and formally makes espionage an integral part of U.S. policy. Although virtually every American citizen can see the need for continuous surveillance of the Soviet Union by whatever effective methods are available and will tacitly support these efforts, it is quite another matter to publicly announce that espionage and violation of another country's territory have become an official policy.

This policy, which is unprecedented in the history of nations, leaves our allies in an untenable position and forces the Soviets to carry this matter much further than they may have originally intended. It appears to be another one of those hasty, poorly thought out, improvised policies aimed at a quick fix with not much thought for future consequences or other implications.

Third, of course, comes the Central Intelligence Agency, in this incident stripped of all its protective secrecy, and standing nakedly exposed in an incredibly amateurish performance compounded from inadequate training, faulty execution and rather transparent cover operations. Apparently, all that was adequately provided in this operation was the $30,000-a-year salaries for the pilots. Whatever reasons impelled Francis Powers to decline to carry out the traditional self-destruction orders of the espionage agent apprehended red-handed by the enemy may never be known. Suffice to say his embarrassing survival was not in the best tradition of either USAF, the agency that originally trained him, or CIA, the agency that hired him without training him properly in its specialized requirements.

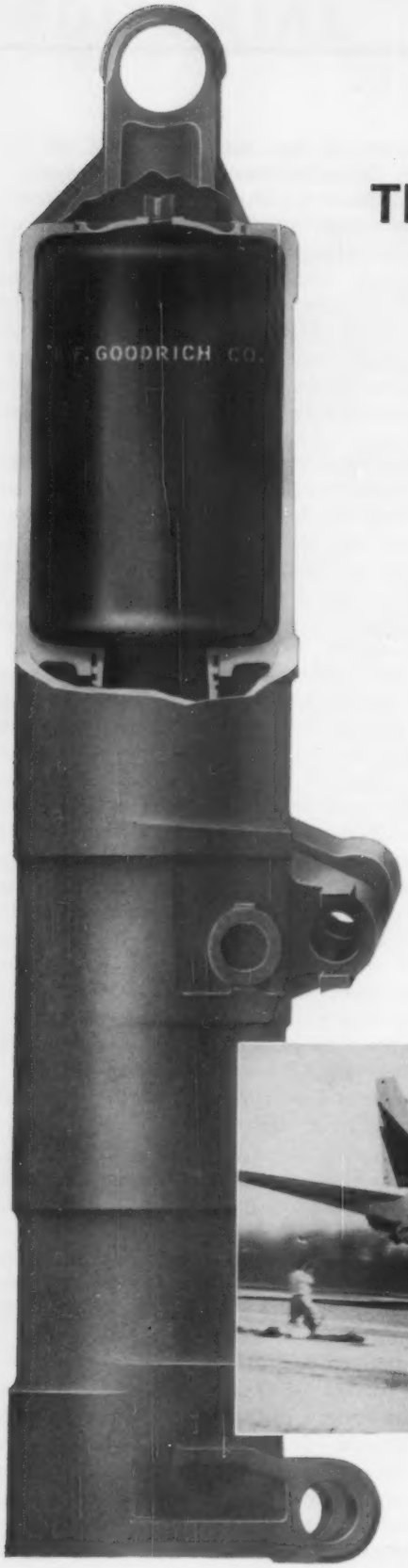
The need for a congressional or some other "watchdog" operation over CIA was never more apparent.

Finally the most important aspect of the U-2 episode is the illumination it must shed for most Americans on the simple salient fact that we are in fact fighting a war against the forces of communism. It is a far different war than we have ever fought before and it is being fought with weapons that we are not accustomed to using. The bungling, naivete and innocence our various government agencies have displayed in the U-2 episode show clearly that we are not yet organized for this type of conflict nor do we yet really understand its scope and strategy.

Although too few Americans realize it, we are already deep into this struggle to determine whether the Soviet system or our own will prevail. If we hope to preserve the basic elements of this civilization we cherish, we must dedicate ourselves more thoroughly to this task and organize our national resources and policies more effectively to achieve this goal. —Robert Hotz

B.F.Goodrich

THERE'S A TAKEOFF IN THAT RUBBER BAG



Douglas Aircraft engineers wanted to store pressurized air for emergency jet engine starting on the DC-8 overseas model. Rather than using valuable space inside the aircraft, they came up with the novel idea of storing air in the cavity in each main landing gear strut.

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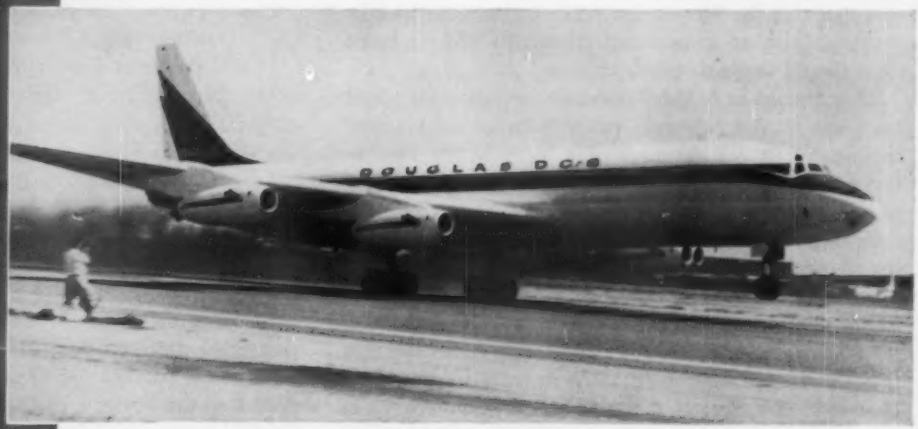

WHO'S WHERE

In the Front Office

William L. Rogers, vice president-Azusa plant, Aerojet-General Corp., Azusa, Calif.

William T. Smither, general manager of Servomechanisms, Inc., Hawthorne, Calif. Mr. Smither, a company vice president, also continues as manager of the Los Angeles Division.

William T. Snebold, president and chief executive officer, Linair Engineering, Inc., Inglewood, Calif.

E. Earl Milner, Jr., president and a director, Electrol, Inc., Kingston, N. Y.

G. Barron Mallory, president, P. R. Mallory & Co., Inc., Indianapolis, Ind., succeeding **Joseph E. Cain**, now co-chairman of the board.

Noah Dietrich, a director, Transval Electronics Corp., El Segundo, Calif. Mr. Dietrich is chairman and director of Houston Fearless Corp.

Herman Fialkov, a director, Dorne and Margolin, Inc., Westbury, N. Y. Mr. Fialkov is president of General Transistor Corp.

Dr. Franklin E. Lowance, president, Advanced Technology Corp., Santa Barbara, Calif., a subsidiary of Electronic Communications, Inc.

A. M. Rochlen, vice president, Hill and Knowlton, Inc., Los Angeles, Calif. Mr. Rochlen, vice president of Douglas Aircraft Co. before retiring, will continue as special consultant for Douglas.

Zeus Soucek, vice president of Grand Central Rocket Co.'s Eastern Region, Washington, D. C.

E. Fred Buehring, a vice president, Temco Aircraft Corp. and division manager of Temco Overhaul & Aerosystems, Greenville, Tex.

Robert H. Garretson, executive vice president, Consolidated Electrodynamics Corp., Pasadena, Calif., a subsidiary of Bell & Howell Co.

John E. Koster, executive vice president, Interstate Engineering Corp., Anaheim, Calif.

Ernest A. Cutrell, one of the nation's leading authorities on development of all-weather operations for transport aircraft, has joined the aviation consultant firm of R. Dixon Speas Associates, Manhasset, N. Y.

Robert O. Bullard, vice president and general manager, Electronics and Instrumentation Division, Baldwin-Lima-Hamilton Corp., Waltham, Mass.

George C. Stewart, vice president-customer relations and contracts, Air Logistics Corp., Pasadena, Calif.

Asa E. Snyder, executive vice president, USI Technical Center, Pompano Beach, Fla., a division of U. S. Industries, Inc.

R. Harvey Whidden, executive vice president-marketing, Bulova Watch Company, Inc., New York, N. Y.

Capt. Paul J. Burr (USN, ret.) has been appointed Technical Services Director of the Institute of the Aeronautical Sciences, New York, N. Y.

P. G. Smith, executive vice president, and **Donald E. Butler**, vice president-sales, Royal Jet Division of Royal Industries, Inc., Alhambra, Calif.

(Continued on page 149)

INDUSTRY OBSERVER

► **Launching complexes at the Pacific Missile Range, Calif., for Air Force's Midas and Samos polar-orbiting reconnaissance satellite systems are almost complete. One is now being checked out with a "whalebone" test vehicle in place; the other is approximately 90% complete. The two Atlas-type pads are designed to take either Samos or Midas interchangeably.**

► Launch of Navy-Advanced Research Projects Agency's Transit IIA probably will be postponed by at least one month. ARPA-Army Signal Corps delayed repeater communications satellite Courier IA is now scheduled to be launched on July 15. Date for Transit IIB is now set for Nov. 1.

► **Areas of engineering specialization assigned to the seven Mercury space pilots when they first began training will determine which one rides which flight in capsules boosted by Redstone and Atlas missiles. Flight training program and orbital flight program will be divided into missions aimed at special checkout of guidance and control system, recovery system, navigation, life support system, etc.**

► Adoption of the European metric system for parts used in U. S. lunar payloads to permit future lunar explorers to scavenge parts for construction and repair from both U. S. and USSR payloads is being considered by National Aeronautics and Space Administration's Jet Propulsion Laboratory.

► **At least nine major defense contractors have agreed to a new Air Force program for sharing the cost of contractor-initiated research programs which previously could be charged off fully against defense production (AW Feb. 22, p. 29). Under agreements reached to date, Air Force will allow contractors to charge off 40 to 70% of research program costs, with companies underwriting 60 to 30% of the total. Sharing ratio varies with individual companies and their programs. General Electric, International Business Machines Corp., North American Aviation and Republic Aviation were among the first to sign.**

► Construction of a steerable 800-ft.-dia. radar telescope powered by a multi-megawatt transmitter for astronomical studies of the solar system has been proposed to several government agencies by Stanford University and Stanford Research Institute. Radar astronomy has certain advantages over radio astronomy because it does not depend upon radio energy emitted by stars and planets. However, it is considered complementary, rather than competitive, with the latter. Largest steerable antenna to date is the 600 ft. radio telescope being built at Sugar Grove, W. Va., by the Naval Research Laboratory.

► **Competition for GJQ-9 ground checkout equipment for the Douglas Skybolt air-launched ballistic missile and North American Aviation's Hound Dog penetration missile (AW May 9, p. 23) has been won by Bendix. Equipment will be built at Bendix's Teterboro, N. J., facility. Initial order is for two development units and 14 production sets.**

► Safety procedure worked out by Strategic Air Command to ensure that no one man can trigger a hydrogen-warhead-fitted ICBM includes a provision for placing two firing buttons on opposite walls of the control room. Buttons must be pushed simultaneously. Another of the number of safety factors built into the procedure assures that the warhead will not be activated unless it experiences gravity loads on re-entry that have been calculated in the plotted trajectory, preventing a possible nuclear detonation in friendly territory.

► **First Northrop T-38 Talon supersonic trainer is scheduled to be delivered to the USAF Air Training Command's Randolph AFB, Tex., in January, with the first operational planes going to Webb AFB, Tex., in July, 1961. Production plans currently call for a total of 744 T-38s, with 69 funded in Fiscal 1960, 144 in Fiscal 1961.**

► Eglin AFB, Fla., has been chosen by USAF as the test site for development versions of the Douglas Skybolt air-launched ballistic missile.

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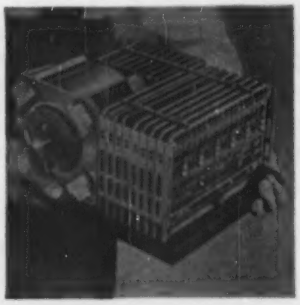
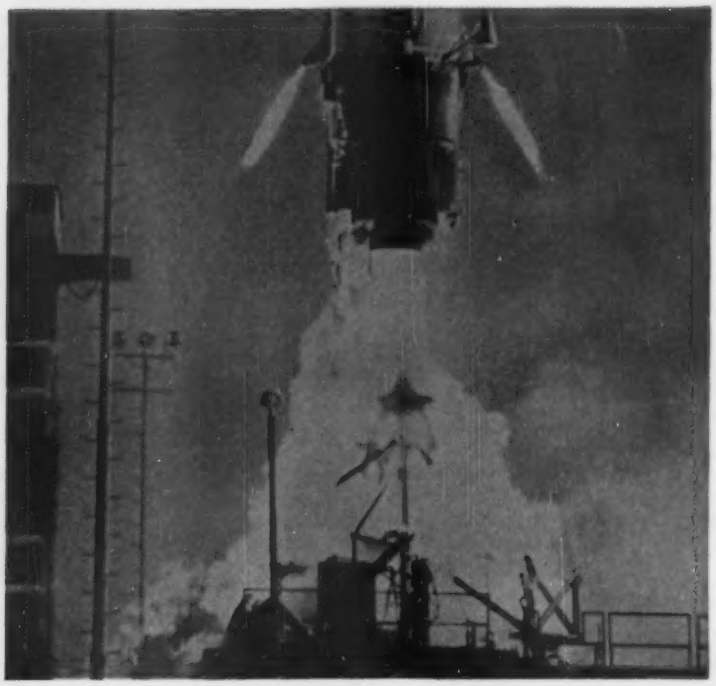


computers that pace man's expanding mind



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Washington Roundup

NASA Biomed Plans

National Aeronautics and Space Administration is assuring Congress that it will not duplicate the military services' work or facilities in space medicine. Dr. Clark Randt, chief of NASA's Office of Life Sciences, says he plans to build a small headquarters staff of 16-18 highly qualified professionals this year.

Randt says NASA will stick to basic research and won't duplicate the services' applied research in the bio-technology field. Space agency plans a small life sciences research center to permit the headquarters staff to keep current on research.

NASA plans to hold meetings of 30-35 experts in space bioscience within the next month or so to discuss improvement of bioscience experiments in space. Group will try to find better ways to use payloads available in space vehicles. It also will plan payloads aimed primarily at biological experiments.

Human factors expert Alfred M. Mayo will join NASA this month as assistant director for bio-engineering in the Office of Life Science Programs. Mayo currently is chief, equipment and safety research, for Douglas Aircraft Co.

Dr. Cornelius A. Tobias will join the space agency life sciences staff about Sept. 1. Dr. Tobias has studied the effects of radiation on humans. He will be on leave from the University of California.

Public Relations Policy

National public relations policy on key space shots is being set by the White House, not NASA, with Brig. Gen. Andrew J. Goodpaster, staff secretary, playing a key role. Latest Goodpaster idea is to bounce a tape-recorded message from President Eisenhower off the Project Echo communications relay satellite. Original tape stressed peaceful use of space, but plans have changed since the U-2 incident.

USAF's Operation Cherrytree, originally scheduled last month at Maxwell AFB, will now be held May 18-20 at Andrews AFB. Purpose of the meeting is to give top Air Force commanders a chance to take a hard look at weapon system development and production programs over the next decade (AW Apr. 4, p. 25). Conference is to determine the hard core of the USAF weapon structure over that period.

Soviet air force commander Chief Air Marshal K. A. Vershinin and nine top aides are scheduled to tour key USAF installations in a cross-country tour of the U. S. Soviet group will attend the Armed Forces Day show at Andrews AFB, then leave on a tour that will include Tactical Air Command headquarters at Langley AFB, Air Force Missile Test Center at Cape Canaveral and Strategic Air Command base at Ft. Worth, Tex.

USAF Missile Concern

Air Force is concerned over its lack of ballistic missile assembly, test and launch capability. USAF has relied on contractors to handle these functions in research and development launches. Contractors are still used as an important supplement to test and training activities at operational bases.

Major Air Force effort to increase its capabilities may come in the Dyna-Soar program. USAF may try to assume the assembly, test and launch roles in the boost-glider program.

Special House group is evaluating the aircraft nuclear propulsion program. Subcommittee of the House Appropriations Committee was established after that group questioned ANP progress when it approved the $75 million Fiscal 1961 request for USAF's share in the program. Members of the special subcommittee now holding closed hearings on ANP are: Reps. George Mahon (D.-Tex.), Harry R. Sheppard (D.-Calif.), Louis C. Rabaut (D.-Mich.), Ben F. Jensen (R.-Iowa) and John R. Pillion (R.-N. Y.).

Russians apparently recovered the capsule ejected from Discoverer II last year which landed on Spitsbergen. Re-entering capsule and parachute were seen and located by three Norwegians. An intense search of the landing area produced no capsule, but there were signs that it had been found and carried to a nearby Russian colony.

Descending capsule should have been easy to see from the Soviet colony, but the Russians denied any knowledge of it when asked. Discoverer II was supposed to eject the capsule south of Kodiak, Alaska, for recovery near Hawaii. A minor malfunction and a programing error fired the retro-rocket prematurely.

Wrapup

Senate Defense Appropriations Subcommittee is scheduled to complete hearings on the defense budget this week, then move into closed meetings to make its final decisions. Senate version of the budget is expected by June 15 . . . General Accounting Office report on Air Force management of its ballistic missile programs is scheduled to go to Congress this week . . . Aviation subcommittee of the Senate Commerce Committee will begin hearings this week on proposed authority for the CAB to limit the type and extent of service in air carrier certificates. **—Washington Staff**

U. S. to Continue U-2 Flights Over Soviet

'Rocket' boast of Russians largely discounted; loss of plane attributed to flameout of engine.

Washington—United States will continue manned reconnaissance flights over the heart of the Soviet Union despite Russian retaliation threats until an effective surveillance satellite system becomes operational and/or an arms inspection agreement is reached.

The decision to continue such flights, which have been under way since 1956 at least, followed in the wake of the May 1 crash of a Lockheed U-2 high-altitude reconnaissance aircraft 1,400 mi. inside Russia near Sverdlovsk in the Ural Mountain region.

It also was a public indication of U.S. official disbelief in Soviet Nikita Khrushchev's boast that the U-2 had been downed by a single anti-aircraft "rocket" while flying at an altitude of 65,000 ft. and his boasts that similar "rockets" could destroy Strategic Air Command's bomber force.

The U-2, piloted by Francis Gary Powers, a civilian under contract to Lockheed Aircraft Corp., actually experienced a flameout of its Pratt & Whitney J75-P-13 turbojet engine near its maximum altitude of about 90,000 ft.

The aircraft had descended to about 37,000 ft. attempting an engine restart when last contact with the pilot was made. Efforts by Powers to restart the U-2 engine had not been successful down to this altitude.

At this relatively-low altitude, or lower, the plane may have been intercepted by either Soviet interceptors or ground-to-air missiles.

Several Versions

The U-2, whose design was begun in 1954, is not the only U.S. high-altitude aircraft available for reconnaissance missions over the Soviet Union.

Other, more advanced manned reconnaissance systems will go above 100,000 ft. using exotic fuels developed during the past five years and a lightweight supersonic airframe. These light metal, boron and hydrogen-based fuels have proved practical for specialized missions, particularly those where the turbojet engines can be overhauled after a few hours of running time.

Cost and handling problems have generally prevented the adoption of these fuels for wide operational use within the Air Force.

There also are several versions of the U-2, whose subsonic airframe is limited by Mach number effects to an altitude of approximately 100,000 ft.

While the U-2 downed over the Soviet Union was powered by a J75 engine, earlier versions were powered by a version of the lower-powered Pratt & Whitney J57. Range and altitude performance also probably have been substantially boosted since the initial design through structural changes and internal improvements.

Gross weight of early versions of the U-2 with slipper tanks on the wings is 17,270 lb., including 995 gal. of fuel. Without the tanks, weight is 15,850 lb., with 785 gal. carried internally.

Lockheed also lists the cruising speed of this version as 460 mph. true airspeed at altitude, top speed as 500 mph. true airspeed. Wing span, as given by the company, is 80 ft.; length, 49 ft., 7 in. Lockheed reports the range at approximately 2,200 stat. mi. without slipper tanks and about 2,600 mi. with them. Range figures are based on having a 100 gal. reserve on letdown.

The Soviets apparently were alerted to the proposed U-2 flight and tracked it by radar from its initial penetration of the Afghan border on a course that took it over Stalinabad west of Tashkent, over Tyura Tam, past Aralsk and on to the Chelyabinsk area where engine trouble apparently developed.

The U-2 downed near Sverdlovsk, which according to Soviet sources, was equipped with extra fuel tanks, was flying a route from Peshwar, Pakistan, to Bodo, Norway, that would have covered more than 3,000 mi.

Main Checkpoints

Main checkpoints on the flight were to have been:

- **Large rocket launching complex** at Tyura Tam just east of the Aral Sea to monitor any space launchings which might be made to coincide with the Soviet May Day celebration.
- **Industrial complex at Sverdlovsk** to report on the status of the new missile defense installation there which has hemispherical, domed launch points rather than the herringbone pattern of the older Russian ground-to-air missile sites that resemble U.S. Nike installations. Vice President Richard M. Nixon reported seeing these domed sites, dubbed "House of David" by the U.S., at Sverdlovsk during his 1959 visit.
- **Archangel and Murmansk**, both of which house large bases for the Soviet navy and air force. Soviet submarine, air defense and long-range bombing forces all have numerous installations in the vicinity of these two cities.

First pictures released by the Soviets in their propaganda barrage over the incident and purporting to show the U-2 wreckage (see p. 30) were quickly discredited by Clarence L. "Kelly" Johnson, Lockheed vice president who had been charged with the aircraft's design. After a thorough study of available photographs, which showed a heavily damaged aircraft, Johnson said not one part could be identified as belonging to the lightweight U-2 and that the small pieces of heavy structure that could be studied closely were definitely not from a U-2. He said the wreckage most probably was that of an obsolescing Soviet Il-28 Beagle light bomber.

Johnson's skepticism, which was voiced in other quarters, including the White House, prompted the Soviets to display the remains of a relatively lightly damaged aircraft at a public exhibition in Moscow's Gorki park and to release new pictures. Lockheed officials, after a study of these photographs, said there was no doubt that the aircraft on display was the U-2.

Mission Responsibility

Aircraft and pilots employed on strategic reconnaissance missions around the periphery of the Communist territory also serve NASA by gathering gust and meteorological data at altitudes of up to 55,000 ft. as part of a four-year-old high-altitude weather research program.

Three reports by NASA and its predecessor agency, the National Advisory Committee for Aeronautics, presenting data gathered by U-2 aircraft have been issued during this time. This data has shown primarily that turbulence at 55,000 ft. is, on the average, half as frequent and half as severe as that at 20,000 ft.

Under procedures established in 1956, the aircraft used in this program are paid for by the Air Force and put out on bailment to NASA for specific periods of time. This practice has been used for many years by both Air Force and Navy to support NACA programs.

The Air Force originally purchased the U-2 for a joint USAF-Atomic Energy Commission high altitude radiation detection research program. The

project, however, was conducted on a sporadic basis, and some of the aircraft were baled to NASA for its weather research program during slack periods.

The Air Force Weather Service acts as administrator for the portion of the NASA program investigating high-altitude weather conditions outside the continental U. S. There are no personnel directly employed by NASA in these overseas activities.

These units apparently take their orders primarily from the Central Intelligence Agency, with NASA receiving only raw weather data from these units.

Cover Plane

On May 1, as Powers' plane flew into the Soviet Union from Pakistan, another U-2 was flying as a cover in the Lake Van region near the eastern border of Turkey. The aircraft over Turkey was following the pattern of a normal weather reconnaissance flight such as those made for NASA.

First reports that a U-2 was missing came on May 3 from the Incirlik Air Base in Adana, Turkey, the aircraft's home base. These reports placed the aircraft in the Lake Van region and said the pilot had reported difficulty with his oxygen system.

Two days later, when Soviet Premier Nikita Khrushchev told a session of the Supreme Soviet that a U. S. reconnaissance aircraft had been downed over the Soviet Union, the U. S. still clung to the Lake Van U-2.

An NASA release, made at State Department insistence, and apparently based upon reports received from Turkey, reiterated the statement that the Lake Van U-2 was missing and that the pilot had experienced trouble with his oxygen equipment.

It added that the aircraft was on a northeasterly course when last heard from and that, if the pilot had lost consciousness it could have strayed across the Soviet border.

The State Department release stated that "there was no deliberate attempt to violate Soviet airspace and there never has been."

These statements stood for two days —until Khrushchev announced to the Supreme Soviet that the aircraft had been downed near Sverdlovsk deep in Russian territory, that Powers had safely parachuted from his crippled plane and that he had admitted flying a reconnaissance mission on orders from his "chiefs."

State Department then issued a statement acknowledging that the aircraft had been sent on a reconnaissance mission over the Soviet Union and officially expressing surprise at the belligerance of the Russian leaders' attack on the U. S. since, it said, they had known of these flights for several years.

In a later statement, Secretary of State Christian Herter said the U. S. intends to continue such flights, terming them necessary to assure the West that it will not be taken by surprise attack. A day later, President Eisenhower gave his tacit approval to the flights and outlined the reasons the U. S. believes they are necessary (see p. 32).

Initial Design

In the initial design of the aircraft in 1954, existing state-of-the-art information was used in the development of the airframe, and no elaborate research program was conducted before work on actual hardware was begun.

Construction of the aircraft is extremely light, a necessity for high-altitude planes. The wings flap noticeably during flight near the ground, and the main landing gear has been reduced to one strut with dual wheels to conserve weight. This strut is located just forward of the center of gravity so that the pilot can balance on it during his landing ground roll.

Wing-tip skids are provided to prevent damage to the wing when the aircraft slows down and the pilot loses lateral control with his ailerons. During takeoff, two small wheels under each wing keep them level. These wheels are held firmly on the ground by a flexible strut inserted in a wing socket so that, on takeoffs, the struts come out of the sockets and the whole assembly remains on the runway.

Small wheel supports the tail section when the pilot lowers it near the end of his landing roll and during takeoff.

U-2 Surface

Surface of the U-2 is exceptionally clean, with flush riveting over much of the aircraft. Careful attention is paid to joints and junctures during manufacture, since a very smooth surface is required to keep friction drag low at high altitudes.

High aspect ratio, sailplane-type wing was used on the aircraft to permit it to operate at high lift coefficients during cruise with a small penalty in drag due to lift. The turned-down wing tips that form the skids for landing increase the effective aspect ratio of the wing and make it more efficient for the U-2 mission.

Primary mechanical modification to the J57 powerplant in initial installations was the use of larger, wide chord compressor blades to pump thin, low-density air more efficiently than those on normal turbojet installations which must function effectively through a wide altitude range.

Wreckage Displayed

Moscow—Underside damage predominated in the sections of wreckage of a blue-black unmarked Lockheed U-2 the Russians put on display here last week. Greatest degree of damage appeared to be in the center section and to the Pratt & Whitney J75-P-13 turbojet engine.

Vertical tail surfaces were less damaged than the underside of the tail section. Trailing edges of both wings were torn and there were holes from one to ten inches in diameter in the right wing. Underside of the left wing showed very little damage. Slipper tanks on the wings were bent upward and the left one was flattened on the bottom.

Unofficial Soviet sources maintained the airplane was hit by a rocket in the engine section. Equipment described by the Soviets as radio and ground radar reconnaissance systems was displayed along with dome antennas carrying designations of MP 11719 and MP 12570. Seven glass ports for cameras were noted by observers and a 9x18 in. film size camera designated 73B and an astro-tracker for calibrating pictures taken in flight by reference to the sun also were included.

Airspeed indicator needle was stuck on 340 kt. Altimeter needle was gone. None of the pilot's survival equipment displayed appeared soiled or damaged.

Lettering on the wing "Fuel only with MIL-F-25524A" correspond with markings on U-2s photographed in the U. S. (see p. 29, lower left photo).

SAC U-2 Fleet

Strategic Air Command has a fleet of 15 U-2 aircraft which are used for training purposes, high altitude weather research and nuclear radiation detection missions. Other USAF U-2 aircraft have been assigned to Air Research and Development Command.

Soviet Missile Command

Moscow—Soviet Union has established a separate missile command, apparently on a level equal to that of its air force, army and navy.

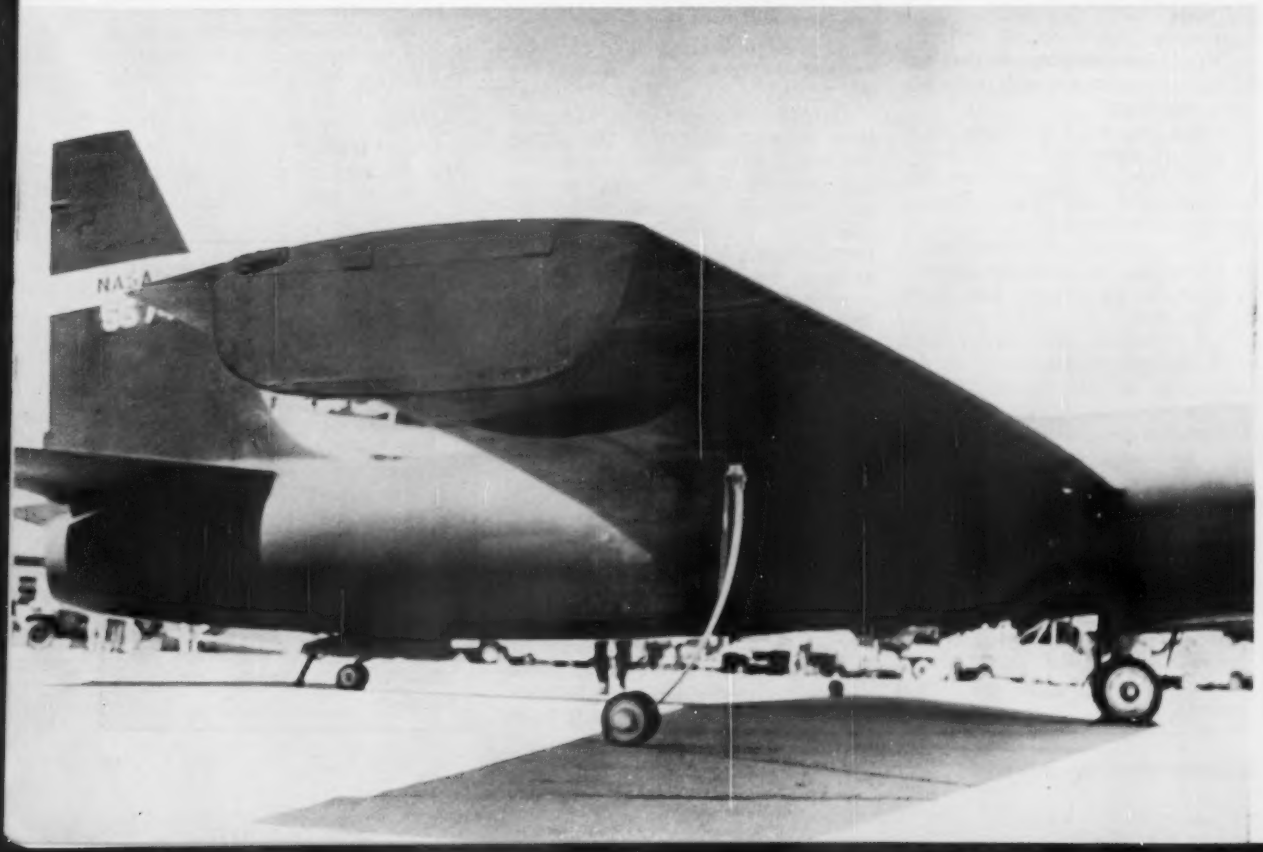
New service is under the command of Marshal Mitrofan Ivanovich Nedelin, who has headed the Soviet army artillery and served as chief of the principal artillery administration in the Ministry of Defense for the past 10 years.

First indication of the separate command came shortly after Soviet Premier Nikita Khrushchev's initial announcement that a Lockheed U-2 aircraft had been downed over Russian territory. At a formal reception, Khrushchev introduced Nedelin as "Marshal of Rocketry Nedelin."

Extremely clean wing-fuselage juncture and engine air inlet design are shown in these photographs of a Lockheed U-2 with National Aeronautics and Space Administration markings taken at Edwards AFB, Calif., five days after a U-2 was lost near Sverdlovsk, Russia. Slight droop of the wings indicates their light construction.

Extreme Cleanness, Manufacturing Care Mark U-2

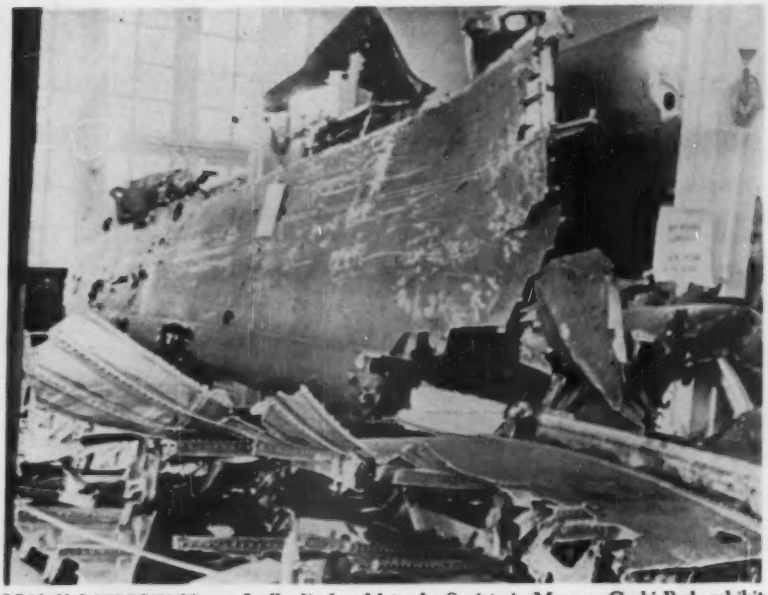
Unusual landing gear on the Lockheed U-2 provides considerable savings in structural weight; an important factor for high altitude aircraft. Small wheels on flexible strut are held firmly on ground by wing weight and drop off at takeoff. Near the end of the landing ground roll, the pilot normally turns onto the grass and heels over on one wing tip skid.



Sole identification marks on the U-2 shown at Edwards are the NASA letters in a small stripe on the tail and a serial number (left). Manufacturing excellence in the U-2 is evidenced on its tail areas which have flush riveting and essentially no mismatch of adjoining skin panels perpendicular to the airflow over the aircraft. The manufacturing tolerances held on the after sections of the U-2 are better than those on the nose of many operational high-speed aircraft. The aerodynamically balanced rudder and elevator installations with almost no gap at the hinge again show extreme manufacturing care. The hand-built U-2s were originally constructed in the Experimental Department of the California Division of Lockheed Aircraft Corp. Nose view of the U-2 (right) shows double truck main gear and its brake system. Large open areas are provided on bottom and both sides of the U-2 nose structure to permit the mounting of a variety of cameras and other reconnaissance equipment. Radar can be mounted in the nose of the aircraft. Main engine air inlets are large for a single engine aircraft and are needed for high-altitude operation. The inlet lips are fairly sharp because of the compressibility problems the aircraft experiences near its maximum altitude. Auxiliary air scoop on the right side of the fuselage is located back under the wing.

Stenciling on the fuselage under the canopy states types of fuel to be used in the aircraft, gives canopy operating and rescue instructions and includes the conventional ejection seat warning sign. Bullet-shaped body on strut at the top of the windshield houses a rearview mirror for the pilot. Details of the aileron and tab installation and the wing tip skid design are shown at right. The tip skid also serves as a partial end plate for the wing and reduces the strength of the wing tip vortex and improves the efficiency of the wing when it is operating at high lift coefficients as it would do during cruise at high altitude.

Soviets Exploit U-2, Boast of Strength



REAL U-2 WRECKAGE was finally displayed later by Soviets in Moscow Gorki Park exhibit after earlier faked wreckage picture had been exposed by Lockheed's Johnson and President Eisenhower. Wreckage shows major portion of U-2 wing panel. Soviets claim to have recovered most of the U-2 reconnaissance equipment intact and description of cockpit equipment indicates they may have recovered this plane relatively undamaged, again casting suspicion on their earlier claim of rocket hits at 65,000 ft. Pratt & Whitney J75 engine from U-2 exhibited in Moscow showed evidence of impact damage. Tail section was intact except for missing rudder tab. U-2 wreckage was painted blue-black and no insignia was visible on wings, fuselage or tail.

FAKED U-2 WRECKAGE is shown in this photo originally released by the Soviets labeled as the wreckage of the U-2 as it was shot down near Sverdlovsk. Wreckage is actually the remains of an Aeroflot Tu-104 jet transport that crashed near Sverdlovsk last February killing an official Chinese delegation to Moscow. C. L. "Kelly" Johnson, Lockheed designer of the U-2, analyzed the structural members showing in this photo and said they bore no resemblance to the lightweight U-2 structure and were probably of a bomber type aircraft. Aeroflot Tu-104 crash near Sverdlovsk was one of few publicly announced in USSR because of large foreign delegation aboard. Faked U-2 wreckage was apparently released to create impression of heavy damage from Soviet anti-aircraft missile whereas genuine U-2 wreckage displayed later in Moscow showed major damage sustained along aircraft belly similar to that from a forced landing. Khrushchev awarded medals to Red Army missile crew who allegedly fired the rocket that supposedly hit the U-2. New type anti-aircraft missiles have been observed in the Sverdlovsk area since last summer.

Moscow—Soviet Union last week exploited the May 1 downing of a Lockheed U-2 reconnaissance plane well inside Russia with boasts of its own defensive strength and warnings to U.S. and its allies that further flights might be met by "more drastic action."

At a press conference called shortly after U.S. Secretary of State Christian Herter said the U.S. plans to continue such flights, Soviet Foreign Minister Andrei Gromkyo warned:

"Once again, the violation of the sovereignty and integrity of foreign frontiers, spying and subversion, are pronounced as the U.S. official policy.

"We shall meet, as the Soviet people have always met aggressors, and aircraft which dare to make a sortie into our borders will be smashed to smithereens."

Gromyko warned that those "who lend bases on their territory for aircraft violating our frontier . . . should know that in the event of a repetition of such provocations, the Soviet Union will be able to render these bases harmless."

Earlier, a Radio Moscow broadcast beamed to the U.S. threatened that, "if these American flights over our territory do not cease, the Soviet Union will be compelled to take more drastic action and the security of the United States will hardly benefit."

The furor over the U-2 crash—and the debate over the actual facts behind it—near Sverdlovsk 1,400 mi. inside the Soviet border was dramatically touched off by Premier Nikita Khrushchev four days after the incident.

In a speech before the Supreme Soviet, in which he failed to mention that U-2 pilot Francis Powers had been captured alive, Khrushchev said:

"That day (May 1) . . . an American plane flew over our frontier and continued its flight into the interior of the Soviet land. A report on this aggressive act was immediately given to the government by the Minister of Defense.

"The government has stated this: Since he realizes what he comes up against when intruding into a foreign territory, if he gets away with it, he will attempt fresh provocations. Therefore, the plane must be shot down.

"This task was fulfilled, and the plane was shot down."

Khrushchev said that, upon being told of the invasion, he personally ordered that the U-2 be shot down.

He saved his greatest propaganda coup until May 7 after U.S. spokesmen had issued a statement that a U-2 flying a high-altitude weather mission in the vicinity of Lake Van near the eastern border of Turkey had been missing since May 1.

The Soviet Premier, after a wait of two days, then retorted in a speech highlighted by a statement that U-2 pilot Powers was in Soviet hands. Khrushchev told the Supreme Soviet:

"The flier testified he had no dizziness nor had his oxygen apparatus failed (as U. S. officials had speculated). He was flying along an assigned course, accurately executing his chiefs' order, switching on and off equipment over preselected targets for gleaning intelligence data on the Soviet Union's military and industrial establishments, and flew on until the very moment his piratical flight into this country's interior was cut short."

He told the Supreme Soviet that the U-2 was hit at an altitude of approximately 65,000 ft. by a "rocket" and boasted that, "if they fly higher, we will also hit them."

A "competent commission of experts" which examined the wreckage of the U-2, Khrushchev said, had established "that this American plane was a specially prepared reconnaissance aircraft" with the mission of crossing "the entire territory of the Soviet Union" from Pakistan to Norway. He added:

"Besides aerial cameras, the plane carried other reconnaissance equipment for spotting radar networks, identifying the location and frequencies of operations stations and other special radio engineering equipment."

Khrushchev also brandished pictures 2 x 2 ft. in size and tapes which he said came from the U-2 and showed, among other things:

- **"Airfields and planes on it."**
- **"Petrol stores."**
- **"Industrial enterprises."**
- **"Signals of a number of** our ground radar stations," Khrushchev said, were recorded on one of the tapes.

Terming Washington's version of the flight "baloney," Khrushchev gave what he termed the "truth" of U-2 mission.

The plane's base was, as Washington said, in Adana, Turkey, Khrushchev said. It was attached to a military intelligence unit headed by Col. William Shelton, numbered 10-10. The 10-10 unit, Khrushchev charged, was using the National Aeronautics and Space Administration, to which the aircraft was attached, as a "cover" while probing Soviet radar installations.

Khrushchev quoted Powers as saying that on May 1 he left Peshwar, Pakistan, flew over the Aral Sea and then headed toward Sverdlovsk where his plane was downed.

He also quoted Powers as saying that he flew into Soviet territory "with instructions to fly along a course indicated on his map over the Aral Sea, Sverdlovsk and other points and reach Archangel and Murmansk before landing at Bodo Airfield in Norway." He said Powers had told Soviet authorities:

"I believe my flight over Soviet territory was meant for collecting information on Soviet guided missiles and radar stations."

Khrushchev said that, after the U-2 was struck by a "rocket," Powers "bailed out by parachute; note he was not ejected by catapult but left through the upper canopy . . . He did this possibly because there was an explosive charge in the aircraft which was to blow the plane as soon as the pilot catapulted. The pilot knew this and possibly was afraid he would be killed in the explosion."

Later, Red Star, the Soviet army magazine, reported that the U-2 "catapult" appeared faulty "and probably would not have worked" had Powers used it.

The Red Star article written by Col. F. Luchnikov and Maj. V. Zhukov said Powers would have destroyed himself if he had attempted to use the ejection system. The article said investigation of the wreckage showed that it contained a cache of TNT designed to go off after the pilot had ejected but that the escape system bore a stamp saying it had last been checked in 1956 and would have failed if used. The explosive mechanism, it added, was in perfect order "and would have spared neither the plane nor the flyer." It added:

"Powers apparently knew his bosses' habits very well. Probably this is why he did not make use of the catapult, realizing what the end would be."

Red Star reported that the U-2 was equipped with extra tanks providing sufficient fuel to carry him the approximately 3,000 mi. needed to cross the Soviet Union.

The article said that, in an interview, Powers had never heard of U.S. aviation magazines mentioned to him and concluded:

"So we are dealing with a stupid, corrupt, greedy adventurer in military form. He has no pricks of conscience that he is a spy."

The article also reported that Powers attributed the crash of his aircraft to an "explosion" in the U-2 engine rather than to a Soviet missile.

Other Soviet publications, however, carried lengthy reports on the actions of the missile crew which supposedly downed the aircraft. Pravda carried this account of the action:

"Interference made search difficult and operators strained their eyes and ears to the utmost. The target was maneuvering and, with each minute, their job was becoming ever more difficult." Noting that U-2's radar blips on the screen were "barely visible," Pravda continued:

"The pirate plane was flying with almost sonic speed at very great altitude. A private," it said, "manipulated the instruments until the target mark was fixed on the plane's course.

"Corp. Kharbargin faultlessly plotted the target flight on a map. Maj. Mikahil Voronov at the command post was given precise parameters of the target, then gave the order to fire.

"The rocket shot through the air, shaking all things around and leaving a fiery trace. Then there was an explosion in the sky meaning destruction of the American plane.

"Our Army has many units like the one which has downed the pirate plane."

Khrushchev Scores Twining

Moscow—Soviet Premier Nikita Khrushchev, in rising anger over the U-2 incident, last week described Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, as a man to be compared with "an animal that may do its dirty doings where it eats."

Recalling the 1956 visit of Gen. Twining, then USAF chief of staff, to Russia, Khrushchev said the American general was "welcomed as a guest" and added:

"He left our country by air and next day sent a plane flying at great altitude to our country. This plane flew as far as Kiev (approximately 200 mi. inside the Soviet Union).

"The question arose—should we protest? I proposed no protest should be lodged. All Twining might be compared to is to an animal that may do its dirty doings where it eats. From such behavior, we drew a conclusion: To improve rockets, to improve fighters.

"Our fighters can fly as high as 28,000 meters (92,000 ft.), but the difficulties of a fighter are, though it can rise high, it is not so easy and simple to find a target in the air; a plane in the air is like a needle in the ocean.

"But a rocket finds its target itself. This is the advantage of a rocket, and we make use of it. We have both fighters and rockets. That is why I say: If there are still politicians who would like to rely on bombers, they are doomed to failure.

"With up-to-date military techniques, bombers will be shot down even before they approach a target."

Earlier, Khrushchev repeated his charge that a U.S. reconnaissance plane flew over the Soviet Union on Apr. 9, adding:

"We should have shot down the reconnaissance plane. . . . However, our military men slipped up, to put it mildly, and we put them on the carpet."

U-2 Missions Approved by Eisenhower

Washington—President Eisenhower last week gave his tacit approval to U. S. reconnaissance flights over the Soviet Union. At the same time, he documented the formal U. S. position on such flights and, more specifically, on the Lockheed U-2 lost near Sverdlovsk on May 1. In a prepared statement presented at his weekly press conference, the President said: "The first point is this: The need for intelligence-gathering activities.

"No one wants another Pearl Harbor. This means that we must have knowledge of military forces and preparations around the world, especially those capable of massive surprise attacks. Secrecy in the Soviet Union makes this essential. In most of the world, no large-scale attack could be prepared in secret, but in the Soviet Union there is a fetish of secrecy and concealment. This is a major cause of international tension and uneasiness today. Our deterrent must never be placed in jeopardy. The safety of the whole free world demands this.

"As the Secretary of State pointed out in his recent statement, ever since the beginning of my Administration, I have issued directives to gather, in every feasible way, the information required to protect the United States and the free world against surprise attack and to enable them to make effective preparations for defense.

"My second point: The nature of intelligence-gathering activities.

"These have a special and secret character. They are, so to speak, 'below the surface' activities.

"They are secret because they must circumvent measures designed by other countries to protect secrecy of military preparations.

"They are divorced from the regular visible agencies of government which stay clear of operational involvement in specific detailed activities.

"These elements operate under broad directives to seek and gather intelligence short of the use of force—with operations supervised by responsible officials within this area of secret activities.

"We do not use our Army, Navy or Air Force for this purpose, first to avoid any possibility of the use of force in connection with these activities and, second, because our military forces, for obvious reasons, cannot be given latitude under broad directives but must be kept under strict control in every detail.

"These activities have their own rules and methods of concealment which seek to mislead and obscure—just as in the Soviet allegations there are many discrepancies. For example, there is some reason to believe that the plane in question was not shot down at high altitude. The normal agencies of our government are unaware of these specific activities or of the special efforts to conceal them.

"Third point: How should we view all of this activity? It is a distasteful but vital necessity.

"We prefer and work for a different kind of world—and a different way of obtaining the information essential to confidence and effective deterrents: Open societies in the day of present weapons are the only answer.

"This was the reason for my 'open skies' proposal in 1955, which I was ready instantly to put into effect—to permit aerial observation over the United States and the Soviet Union which would assure that no surprise attack was being prepared against any one. I shall bring up the 'open skies' proposal again at Paris—since it is a means of ending concealment and suspicion.

"My final point is that we must not be distracted from the real issues of the day by what is an incident or a symptom of the world situation today.

"This incident has been given great propaganda exploitation. The emphasis given to a flight of an unarmed non-military plane can only reflect a fetish of secrecy.

"The real issues are the ones we will be working on at the summit—disarmament, search for solutions affecting Germany and Berlin, and the whole range of East-West relations, including the reduction of secrecy and suspicion.

"Frankly, I am hopeful that we may make progress on these great issues. This is what we mean when we speak of 'working for peace.'"

Asked if there have been Soviet reconnaissance flights "over the western part of the world," the President replied:

"Well, I could just say this: As far as I know, there has never been any over the United States."

Earlier, in reply to a query as to whether he saw any chance of success at this week's Summit Conference in Paris in view of the strong denunciations of the U. S. emanating from Moscow, the President pointed out that the Soviets have been, and presently are, actively engaged in espionage in the U. S. Referring specifically to the trial of Soviet Col. Rudolph Abel, he said: "Well, I say yes. I have some hope, because these things have been said for many years, ever since World War II, and there is no real change in this matter.

"Now, if we—I wonder how many of you people have read the full text of the Abel trial, the record of the trial of Mr. Abel. Well, I think he was sentenced to 30 years. Now, this business of saying that you're doing things that are provocative, why, they had better look at their own record. And I'll tell you this:

"The United States and none of its allies that I know of has engaged in nothing that would be considered honestly as provocative. We are looking to our own security and our defense, and we have no idea of promoting any kind of conflict or war. This is just, its absolutely ridiculous, and they know it is."

The President was also asked if he planned to order acceleration of the development programs for the Air Force Midas and Samos reconnaissance

President's Visit in Doubt

Moscow—Soviet Premier Nikita Khrushchev indicated last week that he may be considering the withdrawal of his invitation for President Eisenhower to visit the Soviet Union in June.

Reversing earlier statements in which he had taken pains to disassociate the President from responsibility for U. S. reconnaissance missions over the Soviet Union, Khrushchev told newsmen that his opinion of the President has now changed "of course."

Khrushchev, during a tour of an exhibit in Moscow's Gorki Park allegedly showing the wreckage of the Lockheed U-2 downed near Sverdlovsk on May 1, was asked if he still wants President Eisenhower to visit the Soviet Union. He replied:

"What would you like me to say? Get up here in my place and reply.

"The difficulty is—and I say it frankly—that my hopes in him have not been justified.

"After all, I am responsible for the Soviet government. The Russian people are open-hearted. Can I expect them to welcome him as a dear guest?

"I would be mad to say to the Russian people to welcome as a host a man who sends espionage planes here."

satellite systems. Eisenhower replied:

"Well, I know of nothing—now, I keep in touch with my scientific advisory committee and operators, and I know of nothing we could do to speed these up. They are research items and, as such, no one can predict exactly what would be their degree of efficiency. So I couldn't make a real prediction of what is going—how useful they are going to be."

In reply to another question as to whether the satellite systems "will ease our worries on the question of secrecy," the President said:

"Well, I say, I just can't predict what the final results will be. Now, we do know this, right now. I believe it's either Tiros that is sending back constantly pictures on the cloud cover all around the earth, and that is admittedly a rather rough example of what might be done in photography. But that is being done constantly, and I don't know how many thousands of photographs have been taken, and they send them back on command."

U-2 Developmental and Operational Chronology

Following is a chronology of the developmental and operational cycles of the Lockheed U-2:

• Mid-1954—Lockheed began the design of the U-2.

• Late 1955—After flight tests had proven the capabilities of the U-2, the Air Force purchased several of the aircraft for a joint USAF-Atomic Energy Commission high-altitude research program.

• Early 1956—National Advisory Committee for Aeronautics, which had assisted Lockheed in the original design, began planning a high altitude meteorological research program around the U-2 and other aircraft. U-2s operated by NACA were owned by the Air Force and bailed to the civil agency under the arrangement used for the majority of its research aircraft.

• Early 1956—Air Force formed its first U-2 squadron, the Weather Reconnaissance Squadron, Provisional (1st). It first operated from Watertown Strip, Nev., and assisted the USAF-AEC and NACA research programs which occupied the same airfield but were separate.

• Feb. 16, 1956—U-2 crashed in Arizona after fire started in cockpit. Pilot Robert J. Everett bailed out at about 30,000 ft. Everett was a Lockheed employe flying for NACA with NACA pilot number 357.

• May 7, 1956—NACA announces start of its high altitude gust-meteorological research program.

• May 22, 1956—NACA announces it is making preparations to begin the portion of its research program covering the European area. First U-2 operations in Europe were to be from USAF bases in England with the Air Force Air Weather Service providing logistical support. All planes were civilian with civilian contract pilots.

• July 9, 1956—NACA reported that the initial high-altitude weather data gathered by the U-2 had been processed and that it had proved the value of the aircraft as a research tool.

• Sept. 17, 1956—U-2 crashed near Kaiserlautern, West Germany. Pilot was Howard Carey, a Lockheed employe.

• February, 1957—NACA released first U-2 pictures.

• Mar. 27, 1957—NACA published Research Memorandum RM L57A11 entitled "Preliminary Measurements of Atmospheric Turbulence at High Altitude as Determined From Acceleration Measurements on a Lockheed U-2 Airplane." This report was unclassified, as are all other reports concerning the high-altitude weather program.

• April, 1957—U-2 crashed in isolated region of northwest Nevada killing Lockheed engineering test pilot Robert L. Sieker.

• July 2, 1957—NACA report RM L57G02 was written entitled "Airplane Measurements of Atmospheric Turbulence at Altitudes from 20,000 to 55,000 ft. over the Western Part of the United States," which contained more data taken by a U-2.

• May, 1958—Articles published in the Soviet air force newspaper Soviet Aviation indicated that Red Air Force intelligence was concerned over U. S. operations with the U-2. One article complained that the U-2 "lacks all identification marks indicating its mission." The Soviet writer then suggested that strategic reconnaissance was included among the high-altitude research activities of U-2s based at Wiesbaden, West Germany.

• March, 1958—Japanese magazine Air Review ran pictures of U-2s landing in Japan reportedly taken by a 16-year-old boy standing at the end of the runway.

• Apr. 17, 1959—NASA personnel finished third report on U-2 weather research data. This paper, NASA Memo 41759L, was entitled "Airplane Measurement of Atmospheric Turbulence at Altitudes From 20,000 to 55,000 ft. for Four Geographic Areas." These areas were Western Europe and England, Turkey, U. S. and Japan.

• Sept. 24, 1959—U-2 made an emergency belly-landing with slight damage at Fugisawa airfield while it was attempting to land at its base at Atsugi Airport near Tokyo. Six U-2s were based in Japan at the time, and it was reported that at least some of them flew almost every day.

• Nov. 28, 1959—New York Journal-American published an article by George Carroll on U. S. reconnaissance over Russia which suggested that U-2 flights were used for this purpose.

• Dec. 12, 1959—Article in Soviet Aviation discussed U. S. strategic reconnaissance activity with the U-2 and gave some of the design details of the aircraft. The Soviet newspaper quoted Carroll's article and other material which had appeared in Model Airplane News in March, 1958.

• May 3, 1960—U-2 based at Adana, Turkey, reported missing since May 1 on weather mission in Lake Van region near the eastern border of Turkey by U. S. officials in Adana. Report says the civilian, Lockheed-employed pilot had radioed he was experiencing trouble with his oxygen equipment. Missing plane was officially assigned to NASA.

• May 5, 1960—Soviet Premier Nikita Khrushchev tells the Supreme Soviet that a U. S. aircraft has been shot down over Russia. NASA's Washington headquarters reports that it had been told the U-2 missing in the Lake Van region may have strayed over the Soviet border while the pilot was unconscious because of lack of oxygen.

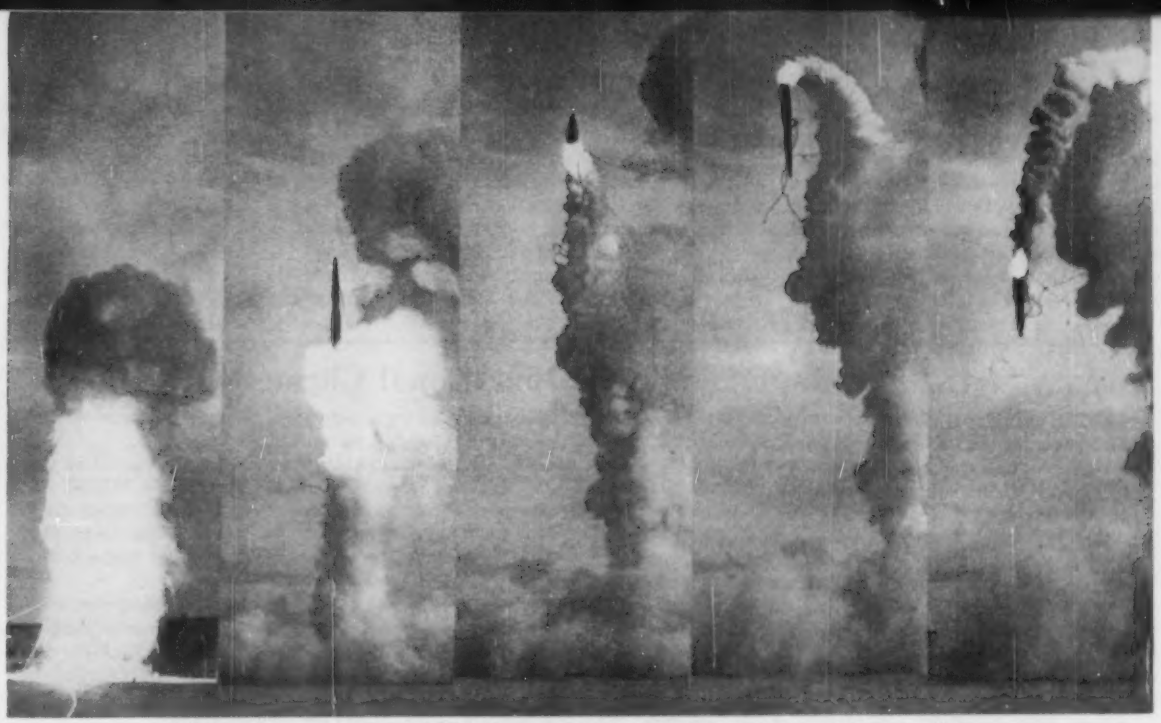
• May 6, 1960—State Department said, "There was no deliberate attempt to violate Soviet airspace and there has never been."

• May 7, 1960—Khrushchev retorts that the aircraft was downed near Sverdlovsk well inside the Soviet Union, that the pilot had been captured alive and admitted attempting a photo-reconnaissance mission across the Soviet Union from Pakistan to Norway. U. S. State Department then issued a statement acknowledging that "an unarmed civilian" aircraft probably had made an information-gathering flight over Soviet territory. It denied that authorization came from Washington.

• May 9, 1960—Secretary of State Christian Herter admits that U. S. reconnaissance planes have collected information on the Soviet Union by flying along its borders and "on occasion by penetration." Herter indicates the U. S. will continue such flights, which, he says, are conducted under broad directives from President Eisenhower.

• May 10, 1960—Soviet Foreign Minister Andrei Gromyko issues a formal note of protest over the U-2 incident to the U. S. Embassy in Moscow.

• May 11, 1960—President Eisenhower at his weekly press conference gives tacit approval to reconnaissance flights over the Soviet Union and the reasons the U. S. believes they are necessary.



Minuteman ICBM Tethered Test Vehicle Fired From Silo

Minuteman ICBM test vehicle is fired from a silo at Edwards AFB, Calif., in one of seven successful silo launchings (AW May 9, p. 28). Improvised nose cone is for ballast. The vehicle is restrained by a nylon tether which interrupts the flight after a few seconds.

Space Technology

Pioneer Switched to 150-Watt Unit

Washington—Pioneer V began broadcasting space data through its 150-watt transmitter last week, but battery troubles have dimmed prospects of getting useful data from the space probe at distances as great as the hoped for 50 million mi. (AW May 9, p. 32).

National Aeronautics and Space Administration turned on the 150-watt transmitter after data broadcast from the five-watt transmitter became almost useless and when it became apparent that the probe's batteries are degenerating. Pioneer V was 8,001,000 mi. from earth when the 250-ft. Jodrell Bank radio telescope at Manchester, England, commanded the first transmission from the 150-watt unit.

Since the larger transmitter draws a great deal more power than the five-watt unit, ground stations can interrogate the probe for only a few minutes every six to eight hours. Broadcasts begin when battery power is at 18 volts, and the system has an automatic cutoff that terminates transmission when power drops below 15 volts. This was cutting off transmissions from the five-watt transmitter just before the shift was made to the larger unit, and last week it was limiting transmissions to about a minute and a half.

NASA deduces from this relatively-rapid power drop that the 28 battery cells are leaking. One theory is that the ambient gas in the batteries is leaking after two months in space.

Following the switch, Manchester could receive data at the rate of either 8 or 64 bits per sec. Both Manchester and the station at South Point, Hawaii, were taking data at one bit per second before the switch. The data received at Hawaii had been unusable for two weeks, and the data at Manchester had become very poor.

The station in Hawaii will continue to receive data at one bit per second. At this rate, it takes 44 min. to get a complete readout of data on the seven channels stored by the Pioneer V telemetry system. A complete readout can be obtained in 1.5 min. at 8 bits per sec. and in 12 sec. at the 64-bit rate. As distance increases, Hawaii will be out of range and Manchester will be reduced to receiving one bit per second. Diminishing power will make it difficult to obtain data at that rate.

The five-watt transmitter had broadcast 109 hr. of data before the change was made to the 150-watt unit. At its highest rate, the smaller unit broadcast 2.5 hr. of data in a single day; it was down to about 68 min. just before the change. NASA can get only about four minutes of data a day from the larger transmitter because of its greater power demands and weakening power supply.

Manchester station commanded the 150-watt transmitter on and received the first transmission about 1.5 min. later, the time it took for the command signal to reach the probe and for the responding broadcast to reach earth. This initial transmission followed a sequence of command signals which prepared the 150-watt system for use.

The day before the first transmission, Manchester commanded power into the tubes through a resistor, warming the filaments for about a minute. Six hours later, this step was repeated without the resistor, supplying full filament heating for several minutes. First transmission command was sent from Manchester early the following day, May 8.

Transmitter and its converter operated after remaining idle in space for two months. Packaged in the probe by Space Technology Laboratories, the transmitter was constructed by Spectrolabs, Inc. It uses Radio Corp. of America tubes and is served by a converter built by Engineered Magnetics, Inc., a division of Gulton Industries, Inc.

Earlier, a malfunction had been detected in the Pioneer V system, and a means was devised of compensating for it in analyzing the data. Bad component was a diode in a temperature-sensing system which produced a battery temperature reading too low for an operating battery. Since the batteries were operating, the trouble was traced to the temperature-monitoring system.

Morane-Saulnier May Build New Seven-Place Jet; Studies Market

Paris—Morane-Saulnier, builder of the successful four-place MS. 760 "Paris" jet executive aircraft, may shortly begin construction of a seven-place twin-jet executive aircraft.

Designated the MS. 861, plans call for the installation of two Pratt & Whitney JT12-A3 turbojets of 3,000 lb. thrust each. With a top speed of 585 mph. and a cruising speed of 540 mph., the MS. 861 is designed for a normal operating range of 1,400 mi.

Serge Saulnier, company sales director, told AVIATION WEEK the decision to move ahead with the privately-financed project depends on the outcome of an international market study now being carried out in the U.S. and elsewhere. Purpose of the study is to establish whether a market exists for at least 100 MS. 861s. Based on this minimum figure, the company is considering a price of $500,000 for the aircraft. Price includes complete instrumentation for IFR navigation and automatic flight.

Saulnier said the market study was near completion and that reaction to the aircraft was encouraging. Final decision whether to launch the project will be taken in the near future. If approved, the company expects to fly the prototype within 18 months and roll out the first production version within two and a half years.

MS. 861 bears some resemblance to its smaller sister, the twin-jet MS. 760. In fact, Morane-Saulnier designed the MS. 861 to tap a market it originally had hoped to capture with the Paris. The latter aircraft, of which 80 have been ordered to date by civil and military buyers in 11 different countries, hasn't made much of a dent in the executive aircraft market.

In the U.S., for example—despite close ties between the French company and Beech Aircraft—only five Paris aircraft have been sold. Morane-Saulnier officials think the main reason is that the Paris' three-passenger capacity is too restrictive.

In going to six passengers, plus pilot, with the MS. 861, Morane-Saulnier thinks it has the right formula to attract a large portion of the executive aircraft market. The idea is to provide a liaison aircraft capable of matching airline jet speeds, yet able to take off from small runways. MS. 861's takeoff distance is just over 2,000 ft.

With a gross weight of 12,742 lb., Morane-Saulnier says the two Pratt & Whitney JT12 turbojets should give maximum safety margin for single-engine operation.

Swept-back wing consists of two outer panels each attached to a center section constructed integrally with the fuselage. Fuel tanks are located in the wing panels and the center section. In addition, each outer wing panel has a fixed fuel tank fitted into the leading edge. Total fuel capacity is 811 gal.

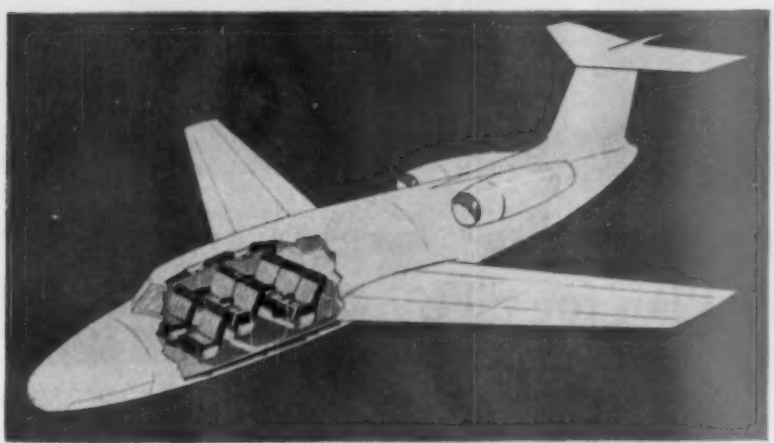
Cabin is pressurized and air-conditioned by hot air bled from engine compressors. Cabin pressure is held at 7,750 ft. The MS. 861 cruising altitude is 24,000 ft. Oxygen equipment is installed for pilot and all passengers.

In addition to 14 cu. ft. of luggage space provided within the cabin, the aircraft has a 21 cu. ft. baggage compartment in the rear of the fuselage.

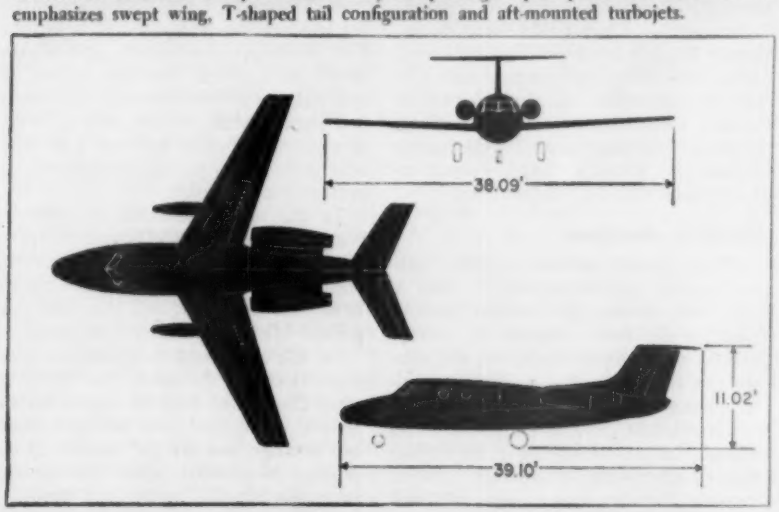
Landing gear is tricycle and tires are kept at medium pressure for landings on grass runways.

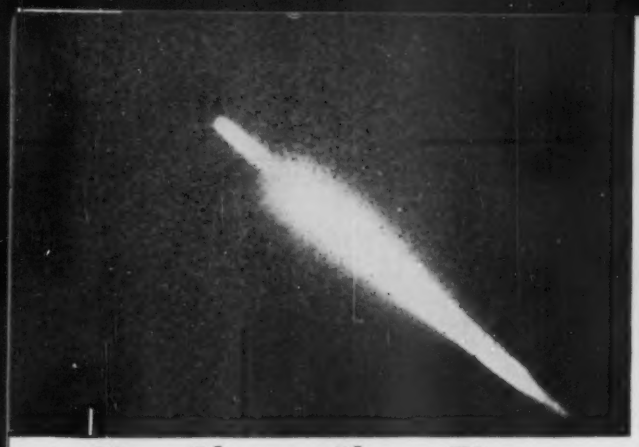
MS. 861 Specifications

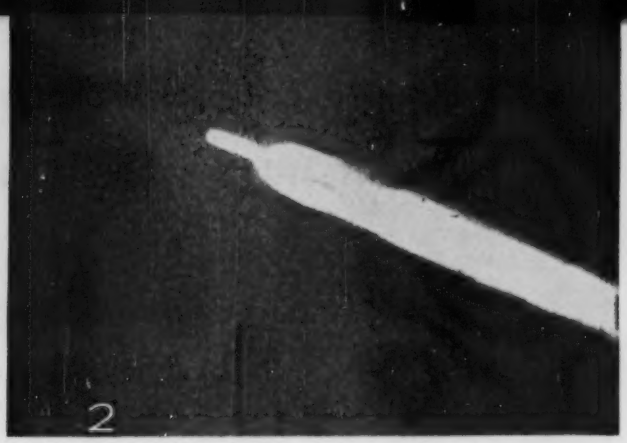
Weights:	
Empty weight	6,017 lb.
Gross weight	12,742 lb.
Dimensions:	
Span	38.09 ft.
Length	39.10 ft.
Height	11.02 ft.
Landing gear track	9.02 ft.
Wheel base	15.05 ft.
Fuselage:	
Maximum diameter	5.4 ft.
Interior diameter (cabin)	5.2 ft.
Cabin length	12.4 ft.
Wing data:	
Wing area	215 sq. ft.
Aspect ratio	7
Sweepback	27%
MS. 861 Performance	
Cruising speed	540 mph.
Maximum speed	585 mph.
Limit speed	Mach .81
Best rate of climb (sea level)	5,520 fpm.
Rate of climb (20,000 ft.)	3,600 fpm.
Range (40 mph. headwind, 30 min. delay, 60 mi. detour, normal reserves)	1,400 mi.
Takeoff distance	2,145 ft.
Fuel capacity	811 U.S. gal.



TWIN-JET executive transport would carry six passengers plus pilot. Below, three-view emphasizes swept wing, T-shaped tail configuration and aft-mounted turbojets.







First Photos Show Titan Second-Stage Ignition

First photos of the upper atmosphere separation and ignition of the second stage of the Martin Titan SM-68 intercontinental ballistic missile show the flight of Titan B7A launched last month at Cape Canaveral, Fla. Flame from the first-stage Aerojet-General LR-87

Burnout of the first stage is reached (5). Successful ignition of the Titan second stage at high altitudes is achieved for the first time in a test flight (6). Explosive bolts break the tie between the first and second stages and a pair of solid propellant JATO bottles mounted on the second stage accelerate the second stage away from the first (7). After ignition of the second-stage 80,000-lb.-thrust

Air Force Outlines Plan for STL

Washington—Details of a plan to form a new non-profit corporation to provide technical support for Air Force ballistic missile and space programs, a task now performed by Space Technology Laboratories (AW Mar. 7, p. 327), have been presented to the House Military Operations Subcommittee.

USAF Under Secretary Joseph V. Charyk told the subcommittee that negotiations currently are under way to acquire existing STL facilities, with an estimated value ranging from $20 million to $30 million, while at the same time an Air Force planning group is working out details of corporate structure, organization and staffing.

The new organization will not perform in the same manner as STL, Charyk said. The corporation's role in an actual development program will be a staff function as a monitor and technical adviser to the Air Force, contrasted to the present situation where STL has a line system engineering responsibility.

Functions to be assumed by the new corporation under Air Force program management, Charyk said, include advanced systems analysis and planning, research and experimentation, initial systems engineering, initial technical direction, and technical monitoring in the field of missiles and space systems.

In addition, Charyk told the subcommittee headed by Rep. Chet Holifield (D.-Calif.) that the corporation will provide assistance in the evaluation of new ideas and proposals submitted by industry in order to ensure the proper interaction between military requirements and technical capabilities.

Detailed Analysis

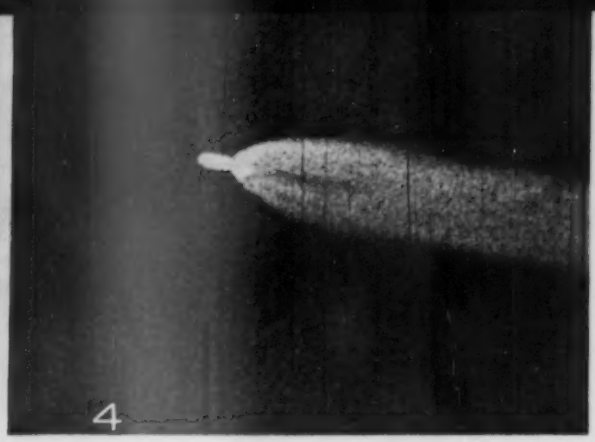
"This detailed analysis, together with supporting experimentation," Charyk said, "will provide the soundest possible basis for the initial engineering specifications of a system, including the subsystems requirements, specifications, interactions and interfaces."

Charyk said the new corporation also will play an important role in the evaluation of the resultant proposals "and so provide the Air Force with the best technical assistance for the selection of the contractors who will have responsibility for the detailed systems engineering and the major sub or associate contractors."

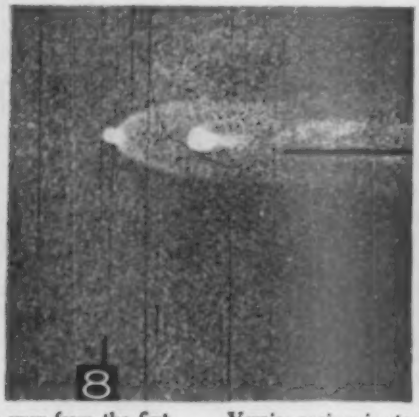
After the contractors have been selected and the development program launched, Charyk said, the new corporation—through technical review, monitoring and analysis—will attempt to ensure that technical deficiencies and weaknesses are isolated, that the impact of new data, new developments and modified requirements on the total systems concept is properly assessed and that appropriate changes are introduced as promptly as possible.

In the transition from the present system, Charyk said STL will continue to retain detailed systems engineering and technical direction for the Convair Atlas, Martin Titan and the solid-propellant Minuteman ICBM programs.

Lt. Gen. Bernard A. Schriever, commander of Air Research and Development Command, told the subcommittee that a board composed of individuals of "prestige and stature" would be appointed to establish policy and run the programs handled by the new group.



double-chambered 300,000-lb.-thrust booster has lengthened to about six times the 98-ft.-long missile (1). First-stage thrust termination is beginning (2). Ballooning and lengthening of the exhaust flame diminishes further during the process of thrust termination (3 and 4). Diamond pattern appears in the exhaust as the missile nears the design altitude of the rocket nozzles (AW Jan. 4, p. 60). Speed now is approximately 5,300 mph. Second stage ignition is programed to begin six seconds after end of first stage thrust.



Aerojet LR-91 engine, the second stage draws away from the first (8). Shock wave forms on the second stage (7, 8, 9). Burnout velocity at missile's warhead separation is more than 17,000 mph. Vernier engines in stage two provide 900 lb. of thrust after shutdown of the main propulsion units for final velocity adjustments (AW Jan. 11, p. 56).

Mercury Tests Begin On Production Capsule

Washington—Partially-equipped production version of the Project Mercury Capsule was flight-tested for the first time last week in a simulation of an escape from the launch pad.

Mercury capsule was launched from National Aeronautics and Space Administration's Wallops Station by its escape rocket, and it was recovered and returned to the beach within 17 min. The capsule was the first production model delivered by McDonnell Aircraft Corp. It was equipped with escape, recovery, communications and electrical systems, but it had no environmental or navigation systems.

Next phase of the Mercury flight test program will involve suborbital flights boosted by Little Joe and Atlas vehicles. Atlas test will provide an engineering evaluation of the skin shingles designed to compensate for heating on the fuselage. Little Joe flight will carry a chimpanzee in a capsule equipped with the life support system.

Capsule tested last week was delivered to NASA on Apr. 2. It was airlifted from McDonnell's St. Louis plant to Wallops Station (AW Apr. 25, p. 32) for a series of component checkouts and to be prepared for the test flight. McDonnell currently has a contract to deliver 20 capsules, and NASA plans to order four more.

On the beach, the capsule was attached to an adaptor by the type of clamp ring that will attach the manned capsule to its Atlas booster. Simulating a launch pad escape maneuver, the clamp ring was released by explosive bolts, and the escape rocket boosted the capsule to an altitude of about 2,400 ft. over the Atlantic Ocean. Drogue parachute was deployed two seconds after explosive bolts separated the burned-out escape rocket and tower from the capsule. Main chute was deployed two seconds later, and the capsule landed about three-quarters of a mile off the beach launch site.

Capsule was recovered by a helicopter from Marine Air Group 26, part of the Navy Project Mercury Recovery Force.

News Digest

Kaman H-43B Huskies turbine-powered crash-rescue helicopters, were grounded by USAF May 9 because of limited clearance between rotors and tail fins, which have been hit by blades.

ACF Industries, Inc., has acquired 214,000 shares of Republic Aviation Corp. common stock from the estate of the late Paul Moore, a Republic founder. Move will strengthen ACF's position in the field of nuclear-propelled rockets, considering Republic's research in that area, according to W. T. Taylor, ACF board chairman.

Atlas-D intercontinental ballistic missile programed for the Wake Island target area was destroyed at 5,000 ft. after an erratic flight. Missile was launched by a crew of the 564th Strategic Missile Squadron from Francis E. Warren AFB, Wyo.

Airlines Protest FAA Recorder Ruling

ATA battles proposal on grounds expense will not justify the 'slight benefits' to the investigations.

By Robert H. Cook

Washington—Airline operators are making a last-ditch stand in an effort to delay Federal Aviation Agency adoption of a ruling that would require the mandatory installation of flight recorders on all turbine-powered aircraft by Sept. 1.

Opposition to the proposal, which is aimed primarily at the Lockheed Electra, Fairchild F-27 and Vickers Viscount turboprop aircraft since they already are mandatory on turbojet equipment, is led by the Air Transport Assn., on grounds that the installation expense and maintenance problems will not "justify the slight benefits to accident investigation." The organization also contends that many of its members have been considering such installations and suggests that FAA stay adoption of the proposal for approximately one year to permit the carriers to evaluate and purchase more sophisticated recorders than those now available on the market.

However, odds that ATA's request will be granted appear slim, according to informed observers, since FAA Administrator E. R. Quesada has taken an aggressive stand on his belief that recorders should be installed on all airline aircraft as soon as possible. Recent series of airline accidents, highlighting the possibility of clear air turbulence as a possible cause factor plus strong urging by the Civil Aeronautics Board that recorders be carried as an aid to accident investigation, make any change in FAA plans even more unlikely.

Why an Amendment

While FAA said that its Sept. 1 compliance date was selected because of the "availability and urgent need" for flight recorders, the agency's notice of proposed rule making conceded that the need for this equipment on all turbine-powered aircraft was a matter of retrospect. Original rule, adopted Sept. 9, 1957, was expected to cover both turboprop and turbojet aircraft on the theory that both types would be operating above 25,000-ft. altitude.

However, FAA explained, certain types of turbine-powered aircraft have been subsequently certificated to operate at or below this altitude and have not been required to carry flight recorders.

As an example, one FAA spokesman pointed out that the Lockheed Electra was originally scheduled for certification to operate at 30,000 ft. but was finally certificated at 25,000 ft.

Further provisions of the proposed amendment require the continuous operation of recorders during flight and retention of recorder information for at least 60 days.

CAB comments on the amendment called for a broadening of the regulation to require recorders on all new transport aircraft, regardless of the height at which they are operated, along with all new transport types in general aviation. The Board also urged that the regulation apply to training, testing and ferry flights of airline aircraft, since the transports might sustain stresses and strains greater than those experienced in normal operations.

In addition, CAB wants the equipment in operation before the aircraft wheels leave the ground on takeoff.

Flight Engineers International Assn. spokesmen told FAA the regulation should be tailored more to aircraft speed than altitude because of the effects of gust load forces. The union said retention of recorder information for one year also would aid in determining the effect of "repetitious" overstresses or operating conditions.

FEIA spokesmen emphasized that the units should be able to record hard landings and urged their use on all aircraft with a takeoff weight above 12,500 lb., regardless of the type powerplants used.

Air Line Pilots Assn. gave the FAA proposal full backing but said flight recorders should be used in all aircraft operating on airways under instrument flight rules.

ATA said its stand against any immediate change in the regulation is "all the more valid" when applied to the F-27. Installation of the equipment on this aircraft would cost local-service operators $350,000 in initial costs without counting maintenance expenses, ATA spokesmen contended.

The organization said the "sketchy" information supplied it by member carriers indicates many carriers would be unable to meet the Sept. 1 compliance date and would be forced to remove aircraft from service.

Types of Recorders

Many airlines are interested in a multi-channel magnetic type recorder which could provide operations and maintenance information beyond that needed for accident investigation, according to ATA. Timetable set for recorder installation, ATA said, is based upon the use of hardware such as Lockheed four-channel recorders now used by a number of airlines.

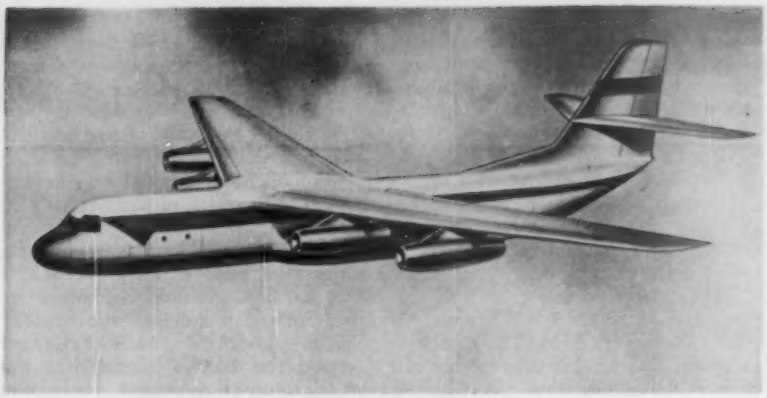
ATA said it favors purchase of a magnetic type recorder being developed by the Minneapolis-Honeywell Co., which can supply them at a rate of 20 per month beginning Jan. 1 on a unit cost of about $10,000. The company plans to conduct a test flight for FAA representatives by the end of this month, ATA said.

Favoring the use of a magnetic, multi-channel-type instrument, ATA said its talks with Minneapolis-Honeywell suggest that those interested in this unit could complete evaluation and installation studies by July or August, 1961.

In the meantime, ATA said other carriers could go ahead and install the currently available recorders, but that, should FAA adopt the regulation change, those desiring other types would be forced into using the current units and would be financially unable to convert to the magnetic type at a later date.

ATA also requested that F-27 operators in Hawaii and Alaska be excluded from the proposed amendment because it said violent weather conditions common to the U. S. are not prevalent in those areas.

Filing by Lockheed Aircraft Service, Inc., with the FAA indicates that the firm's Model 109-C recorder will be available at the rate of 24 units a month by the end of this month, increasing to 184 a month by August. Price quoted of $82,400 for 50 units, including installation, were for the Electra. Cost for the Viscount would be similar; for F-27 and Canadair CL-44 recorders, a bit lower, the manufacturer said.



ADVANCED VERSION of the Lockheed GL 207-42 Super Hercules, powered by four 22,000-lb.-thrust Pratt & Whitney JT3D-11 turbofans (AW Apr. 11, p. 42), is being proposed by the company's Marietta, Ga., Division as a USAF Military Air Transport Service heavy transport with maximum payload capability of 77,000 lb. Lockheed-Marietta says that flyaway prices would be $5.8 million on basis of 50 units, $4.9 million on basis of 100 and $4.3 million if 145 are ordered.

MATS Procurement Plan Calls For Initial Order This Summer

By Katherine Johnsen

Washington—Air Force last week presented to Congress its timetable for modernization of the Military Air Transport Service cargo fleet and new MATS contracting policies aimed at stimulating the purchase of modern cargo planes by the airlines.

Philip B. Taylor, assistant USAF secretary for materiel, made it clear to the House Government Military Operations Subcommittee that Air Force plans to build up and maintain a modern MATS cargo capability in excess of "hardcore" military requirements until there is an adequate commercial cargo airlift for backup in an emergency. He also said that MATS intends to maintain its present utilization rate of five hours a day indefinitely.

Taylor reported that a determination on the "hardcore" mission of MATS—the key to its future size—is scheduled to be made by the Joint Chiefs of Staff in September. The JCS review is now under way.

MATS Plan

This is the MATS procurement plan Taylor outlined:

• **Selection of the aircraft** to be the future backbone and "workhorse" of MATS will be made "shortly after July 1." Proposals have been submitted by several companies. From these, Taylor said he was "most optimistic" that an aircraft meeting MATS requirements —including integral loading equipment, truck-bed height cargo floor, capability for short-field operations and airdrop of cargo and personnel—and also meeting the low operating cost requirement of commercial carriers—can be developed. The House has already approved $50 million in the Fiscal 1961 defense budget for initial development and engineering on this aircraft. Taylor estimated deliveries on the aircraft would start in mid-1964.

• **Taylor estimated** that by Oct. 1 USAF would give the selected manufacturers the go-ahead for production of 100 cargo aircraft for the interim modernization of MATS. These aircraft would be available to MATS early in 1962, and deliveries would be completed by the end of 1963.

Taylor favored procurement of 50 Lockheed C-130Es, but gave no indication as to the aircraft type which might be favored by USAF for the remaining 50 aircraft to meet MATS' longer range turbine-powered requirements. The House has voted $70.4 million in the Fiscal 1961 defense budget for the C-130 purchase, and $250 million for procurement of "the KC-135 aircraft or an aircraft of similar capability." House Appropriations Committee specified only that "it is intended that this cargo aircraft be a side-loading type—which will require the least modification, and thus provide the most immediate delivery—as opposed to the development of a swing-tail version.

Rep. L. Mendel Rivers (D.-S. C.), chairman of the House Armed Services Subcommittee on airlift, strongly favors the KC-135, but Sen. A. S. Mike Monroney (D.-Okla.), chairman of the Senate Commerce Aviation Subcommittee, is opposed to selection of this type on the ground that its landing area requirement is too large and the cost of a cargo adaptation of the tanker would be excessive. As alternatives, Sen. Monroney would favor cargo adaptations of the Boeing 707 or the Douglas DC-8, or the Lockheed GL 207 Hercules.

In connection with procurement of the C-130 and KC-135, or similar aircraft, Taylor pointed out that USAF is studying an alternative "swap deal" under which Air Force would purchase air defense interceptors for Canada in exchange for Canadair CL-44s. Gordon W. Reed, board chairman of Texas Gulf Producing Co. and head of a seven-member committee which recently made a study of MATS (AW Apr. 18, p. 39), recommended an $880 million purchase of interceptors in exchange for CL-44s. Taylor reported that the scope of Reed's proposal was too large, but that USAF "still sees financial advantage in such a swap."

Under MATS' new commercial airlift procurement policies, the "type" of aircraft to be operated under contracts will be given major consideration, thus holding out the lure of MATS business for carriers who buy modern cargo planes. To make this preferential treatment possible, USAF will generally use competitive negotiation in contracting with air carriers. Air Force will not preclude competitive bid contracting, which MATS has generally used in the past, Taylor noted, "where negotiated contracts fail to provide airlift services at reasonable prices." Preferential consideration will also be given to carriers offering expansion capability in an emergency.

Common Carrier Rates

Taylor flatly ruled out paying common carrier rates under MATS contracts and the proposal of four overseas airlines—Northwest Airlines, Seaboard & Western Airlines, Pan American World Airways and Trans World Airlines—to carry all MATS and other government air traffic over points on their routes at reduced rates established by Civil Aeronautics Board (AW Nov. 16, p. 47). Using common carrier rates, Taylor said, would triple the commercial airlift procurement cost to MATS. The four-carrier proposal, Taylor commented, "is a very nice document, but it has no prices in it . . . and the price is the critical element." He emphasized that USAF would never accept any proposal under which it paid the bill and CAB set the rates. Taylor also objected that under the four-carrier proposal, USAF would be precluded from having a say on the type of aircraft to be used.

As an alternative to the four-carrier proposal, Taylor reported, MATS plans to channel a portion of its traffic to certificated route carriers on regularly scheduled flights—provided the carriers

guarantee "an agreed amount" of expansion in ton-miles. The passengers would be ticketed to load and leave the air carrier at commercial airports, except where the airline normally serves a military airfield. To the extent possible, only jet transport aircraft will be used for this passenger traffic, and cargo service would have to be provided with "the most modern cargo aircraft available."

To make MATS business more attractive and assist airlines in financing new jet cargo aircraft purchases, Taylor reported MATS will let long-term contracts—probably for one year, with a government option to renew for two succeeding one year periods.

A specific aim of MATS' new procurement policies, Taylor said, is to preclude MATS business from DC-4 and other obsolescent aircraft.

To assure the availability of modern civil cargo airlift in an emergency, Taylor reported, USAF in the near future will recommend to the Department of Defense the enactment of legislation which will provide:

"In time of war or national emergency, the President, through the Secretary of Defense or his designee, may take possession and assume control of all or part of any system of transportation to transport troops, war materiel, and equipment, or for other purposes related to the war or emergency. So far as necessary, he may use the system to the exclusion of other traffic."

USAF is also considering legislation providing special reserve status for airline personnel, making them subject to call to active duty.

Taylor indicated doubt as to the future necessity of the Civil Reserve Air Fleet. Noting that MATS' new procurement and legislative proposals will largely accomplish the objectives of CRAF, he added: "In some respects they go even further toward providing appropriate types of civil aircraft and using them in a national emergency." USAF will undertake a re-examination of the role of CRAF in the "immediate future," he said.

Taylor also reported that a strategic airlift role has been officially established for Air Reserve and Air National Guard. Phased-out MATS aircraft will be turned over to AR and ANG units to meet airlift reserve requirements.

Lockheed Completes Electra Test; Announces Probable Crash Cause

Los Angeles—Lockheed Aircraft Co. climaxed a two-month-long investigation and test program on its troubled Electra turboprop transport last week with an announcement that two recent crashes of the aircraft were both caused by wing failures resulting from a coupling of vibrations between the outboard power package and the wing.

Referring to the crash of a Northwest Airlines Electra near Tell City, Ind., on Mar. 17 (AW Mar. 28, p. 40) and a Braniff Airways Electra near Buffalo, Tex., last Sept. 29 (AW Oct. 5, p. 28), Lockheed Board Chairman Robert E. Gross said:

"In our opinion, the accident resulted from the dynamic coupling at high speed of oscillatory movements of the outboard power package and wing."

Lockheed spokesmen told a meeting of airline representatives and members of the Air Line Pilots Assn. that, with its investigation virtually complete, the company "expects any additional data developed to confirm the conclusions."

Speculation as to the significance of clear air turbulence in aircraft accidents also was mentioned by Gross who said that, while all tests supported the belief that "some elementary damage" existed in the power package areas of both Electras prior to the accidents, the damage alone could not have caused the accidents. Damage, Lockheed indicated, could have been sustained in hard landings.

"Each airplane encountered an additional external force which also by itself could not have caused destruction, but the combination of the broken or weakened element, plus the external force intensified by high speed, acted as a trigger to set off oscillations, which built up the forces to the breaking point."

The Electra has been operating under an FAA-imposed speed restriction of 225 kt., pending the results of the Civil Aeronautics Board investigation of the two accidents. Gross said that factory tests also show that operation of the Electra under this restriction prevents any repetition of the "multiple phenomena" so that any chance of a recurrence of "dynamic coupling" at higher unrestricted speeds will be eliminated under the program.

While Lockheed declined to reveal further details on the exact fix needed, or the probable individual costs to the airlines now operating a total of 136 of the turboprop aircraft, the company said proposed design changes will be submitted to the FAA for approval within the next few weeks and that modifications, utilizing the company's field bases on the East Coast, abroad and at Burbank, Calif., can begin by July. Gross said Lockheed has already begun engineering changes to permit high speed operation of the transport and added that further design changes, having no possible connection with the accidents, also will be proposed.

Lifting of the speed restriction, FAA sources say, will await complete modification of the aircraft and final determination of the cause of the accidents lies with the CAB.

Gross, however, said he was sure the program of improvements Lockheed is now developing would encompass any likely official findings by the Board.

The Lockheed board chairman termed the Electra investigation one of the "most profound engineering problems" to confront the company in three decades and said that 250 engineers and technicians have worked on a round-the-clock basis to solve the problem. At one point, he said, Lockheed mathematicians fed 59 mathematical equations, involving thousands of variables, into electronic calculators to solve them simultaneously.

Lockheed earlier denied reports that its Electra investigation disclosed the aircraft suffered from structural weaknesses which might cost nearly $72 million to correct.

Gross rebutted that the cost of changes involved in the Electra program would not exceed $25 million.

Reports from some sources have indicated that the Electra fix would include the strengthening of spars under the outboard nacelle and another leading from the wing into the landing gear section. Cost was estimated at $200,000 per aircraft, with Lockheed assuming this cost if the aircraft had not exceeded its factory warranty of 1,800 hr. time.

Explaining how it arrived at its conclusions on the Electra, Lockheed said a model of the wing and its nacelle structure, including the engine, was built for wind tunnel tests. At all speeds and against all external disturbances, including sudden wind gusts, they said, the model of an undamaged structure retained normal stability.

Gradually, the stiffness and bending strength of the combined nacelle and powerplant was reduced, permitting excessive movement up and down, as well as sideward, to simulate the effect of structural damage such as that which might result from a hard landing.

Under these testing conditions, a point was reached at which the weakened model began to oscillate and became unstable so that the movements continued and established similar oscillations in the wings, they said.

"In an Electra without a damaged part in the power package area," Lockheed pointed out, "such oscillations would quickly damp out or disappear, but with damage somewhere on the system, they could continue unchecked."

Port Authority, Airlines Analyze FAA Idlewild Jet Anti-Noise Rules

By Glenn Garrison

New York—Anti-noise regulations proposed last week by Federal Aviation Agency for aircraft operations at New York International Airport generally follow already existing National Air Transport Coordinating Committee procedures for piston and jet aircraft using the airport (AW June 29, 1959, p. 29).

Like the industry anti-noise group's rules, however, the new FAA proposal falls short of what the Port of New York Authority feels is adequate to protect neighboring communities from the noise of jets. The Port Authority in a matter of hours reacted to FAA's announcement of the proposal by calling the rules "inadequate" to afford such protection, and the Port Authority said it will submit its views to FAA after further analysis.

Among the major differences between the FAA's proposed rules and the Port Authority's own prescribed procedures for jet operation is the ban on night takeoffs from any runway other than 25 or 22, which lead aircraft out over water. FAA does not prohibit such takeoffs; Port Authority does prohibit them.

Another Difference

Another difference is the lack in FAA's rules of specific criteria for an accepted noise level over communities adjacent to the airport. The Port Authority sets a minimum, measured on the ground, of 112 "perceived noise decibels," a standard worked out by its consultants and somewhat controversial in the industry.

Comments on FAA's notice of proposed rule making may be submitted prior to June 27, and the effective date will be sometime thereafter, depending on how much additional evaluation or investigation is required. If adopted, the rules will be the first federally enforceable noise abatement regulations in the New York area. Basically similar regulations have been instituted by FAA at Los Angeles International Airport (AW Jan. 4, p. 26).

Airlines in the past have not always been completely faithful to the Port Authority's rules in operating their jet aircraft. For example, the carriers are required to clear each jet takeoff with the Port Authority, reporting gross weight, wind, temperature and other data so the agency can decide whether the planned takeoff will violate the perceived noise decibel limit. Airlines sources have told AVIATION WEEK that a not too unusual sequence of events is a call by the airline with its data, a return call shortly thereafter by the Port Authority disapproving the takeoff, and finally a takeoff on schedule anyway.

The NATCC rules, which take into consideration such economic factors as gross weight and fuel, cargo and passenger loads as well as noise in determining runway assignments, will in general be absorbed in the new FAA procedures if they become official regulations. The NATCC system therefore will be eliminated as such, but NATCC will continue its existence and may add voluntary procedures to those required by law. It will continue on a voluntary basis, NATCC said last week, "to explore all possibilities for additional noise abatement and will cooperate fully with FAA in that agency's noise abatement program."

FAA, which also has been a member of NATCC, last week announced its withdrawal because membership would be incompatible with its rule-making activity in the anti-noise area.

Initial airline reaction to the FAA proposal was emphasis that any FAA regulations would, of course, be followed to the letter. There was some feeling that any obligation to adhere to the Port Authority's rules would be lessened by official legal regulations on the subject.

TWA 707 Damaged In Landing Mishap

New York—Failure to accomplish a go-around after a too-high ILS approach led to an accidental belly landing of a Trans World Airlines Boeing 707-320 jet transport last week at New York International Airport.

The Intercontinental jet, with 100 passengers and a crew of nine, touched down about three-quarters down the length of 8,400-ft. Runway 22L as the landing gear was in the process of retraction. The plane skidded on two pods and the fuselage bottom to a stop about 300 ft. from the end of the strip.

The main gear apparently was retracted and the nose gear still coming up when the plane hit the runway. Friction of No. 2 and No. 3 engine pods against the concrete touched off fires in those engines and the cabin filled with smoke, but all persons aboard escaped and injuries, reportedly minor, were confined to eight of the passengers. Port of New York Authority firefighters extinguished the fires quickly and the airplane will be repaired.

No official results of the investigation of the accident were available last week, but AVIATION WEEK has learned that the pilot, Capt. Harry Campbell, found himself too high after breaking out of the overcast at 400 ft. and made a last-minute decision to go around. Power was applied and gear retraction started, but, with the inherent lag in acceleration of a jet engine, the aircraft sank to the runway before it could break clear.

TWA reported that the decision to go around was made just prior to the landing. Before the procedure could be accomplished, TWA said, the airplane touched down on the runway.

The flight, which originated at Los Angeles, made an ILS approach to the runway, and the contact was made at 4:49 p.m. May 9.

Passengers in the first class forward compartment were evacuated by an emergency chute slide after the flight engineer reportedly assisted the hostesses in inflating and placing the chute at the forward galley exit. In the aft cabin hostesses opened the rear galley emergency exit, according to TWA, and passengers were assisted to the ground from the 6-7-ft. height of the door well. Two male passengers went out an emergency door over the wing in the forward part of the tourist compartment and went back to the outside rear to help the evacuation.

Everyone was off the airplane in three minutes, according to TWA.

Aircraft parts damaged by the accident include the right wing, belly surface, No. 2 and 3 pods, and the nosewheel gear door, which was ripped off the airframe. The plane was towed from the runway to TWA's hangar on its own landing gear after air bags and jacks were used to get the fuselage off the ground. Four tires were changed before the tow was begun.

The airplane was the single 707-320 used by TWA on its domestic routes, recently scheduled transcontinentally with considerable advertising fanfare. It has been replaced on the route with a 707-120, and no plans had been made at mid-week to schedule another 707-320 domestically.

TWA 880 Delivery

San Diego—Convair Division of General Dynamics Corp. will deliver four of an order of 30 Convair 880 turbojet transports to the Hughes Tool Co. for Trans World Airlines this month. Follow-up deliveries are planned at the rate of five aircraft a month, according to Convair spokesmen.

Hughes recently announced plans to undertake a $340 million financing program to cover the cost of the turbine equipment being purchased for TWA (AW Apr. 18, p. 28).

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Eastern Shows Interest in Boeing 727

New York—Eastern Air Lines is interested in the Boeing 727 jet transport for operation into smaller airports and may also be interested in "integration" with a railroad, Chairman Edward V. Rickenbacker said here.

Rickenbacker also discussed before the New York Society of Security Analysts his opinion on the future of the Lockheed Electra turboprop transport in the light of its two as yet unexplained accidents, and his unfavorable opinion of some aspects of Civil Aeronautics Board accounting theories.

Boeing has not yet decided whether to build the 727, the problem being trying to convince potential customers to accept the same basic aircraft to avoid unexpected production costs met in previous jet transport programs (AW May 2, p. 177). United Air Lines and Eastern are showing the strongest interest in the airplane, but American Airlines is also studying short range jets—the 727 and the Convair Model 60 as well.

Aircraft Requirements

Rickenbacker said Eastern was interested in an airplane capable of operating out of airports with runways of a maximum of 5,000 ft. and where local conditions made extension unlikely or impossible. The 727—now designed to use three tail-mounted jet engines—appears to have good economic and operational potential, Rickenbacker said.

Specifications for the airplane are fluid, but those quoted to airlines indicate the design started at 118,000 lb. maximum gross and since has risen to 128,000 lb. The Allison-Rolls-Royce ARB 963 (AW May 2, p. 143) is a strong contender for the powerplant, but the Pratt & Whitney JT10 turbofan or a General Electric engine also are being pushed.

Passenger Configuration

The economics referred to by Rickenbacker include use of the 139-in. fuselage diameter of the Boeing 707, which permits a three-and-three-abreast coach configuration. Length is quoted at 114 ft. 8 in. It would carry 68 first-class passengers, 88 mixed configuration and 114 all-coach.

Convair's Model 60 gross weight would be either 140,000 or 145,000 lb. depending on seating configuration. The swept-wing twin-engine airplane, in the Sud Caravelle range and passenger capacity category, would be powered either by the Pratt & Whitney JT3D-5 turbofan or the General Electric CJ805-41C fan engine and would have a range of 1,200 mi. and cruise at Mach 0.85. It would be available by 1962. Takeoff distance is less than 5,000 ft.—probably nearer 4,000 ft. on short and medium hauls at less than maximum gross weight.

Any United order would be for 1964 delivery (AW Feb. 29, p. 43; related story p. 41 this issue). Such an airplane would give United four distinct weight-passenger class airplanes from the Caravelle at 100,000 lb. and 80 passengers through the Boeing 720 at 203,000 lb. and 110-149 passengers, to the Douglas DC-8.

Rickenbacker disclaimed any interest on Eastern's part in the Caravelle, commenting: "Here is an airplane built in a foreign land 4,000 mi. away. We have trouble enough with people on our own doorstep, servicewise and otherwise."

If Eastern orders the 727, it would supersede the Electra, on many routes, Rickenbacker said, and the Electra would be moved onto routes now being flown by Martin or Convair twin piston-engine equipment. Eastern also is studying the Fairchild F-27E, but has dropped options it held on 30 more Electras.

Electra's Future

Commenting on the future of the Electra in the light of the Tell City, Ind., accident, Rickenbacker defended the airplane and said he felt any fix required would not be too great a problem. He said Eastern flights through that area on the day of the crash had been warned to stay below 13,000 ft. or above 22,000 ft. because of severe turbulence expected near a low-level jet stream, and he felt this was a factor in the accident. An Eastern Electra went under the turbulent area and an Eastern DC-7B over it at the time of

Future Doubtful for HFB-314 Jet

Geneva—Short-term future of the Hamburger Flugzeugbau 314 medium-range jet transport (AW Oct. 19, p. 47) is now awaiting results of a market survey being made by the company at the request of the West German Ministry for Economic Affairs.

The survey is expected to last six to eight weeks and results will influence final decision on whether or not the government will finance further work. Many observers believe that such funding will not be granted and that the project will be dropped quietly within a few months.

The government already is heavily committed to the financing of Lockheed F-104G and Fiat G.91 production, plus sharing development costs of the Transall French-German military cargo transport. It is naturally reluctant to finance any projects which do not have a guaranteed future.

Present status of the 70-seat HFB-314 is that of a "paper project" with calculated performance figures worked out with a choice of powerplants: paired General Electric CJ805-23 turbofans, Pratt & Whitney JT3D-3 turbofans or Rolls-Royce RB.143 bypass engines.

Preliminary figures give the aircraft a cruise speed around 600 mph., range capability between 300 and 1,500 mi. and runway lengths on the order of 5,000 ft.

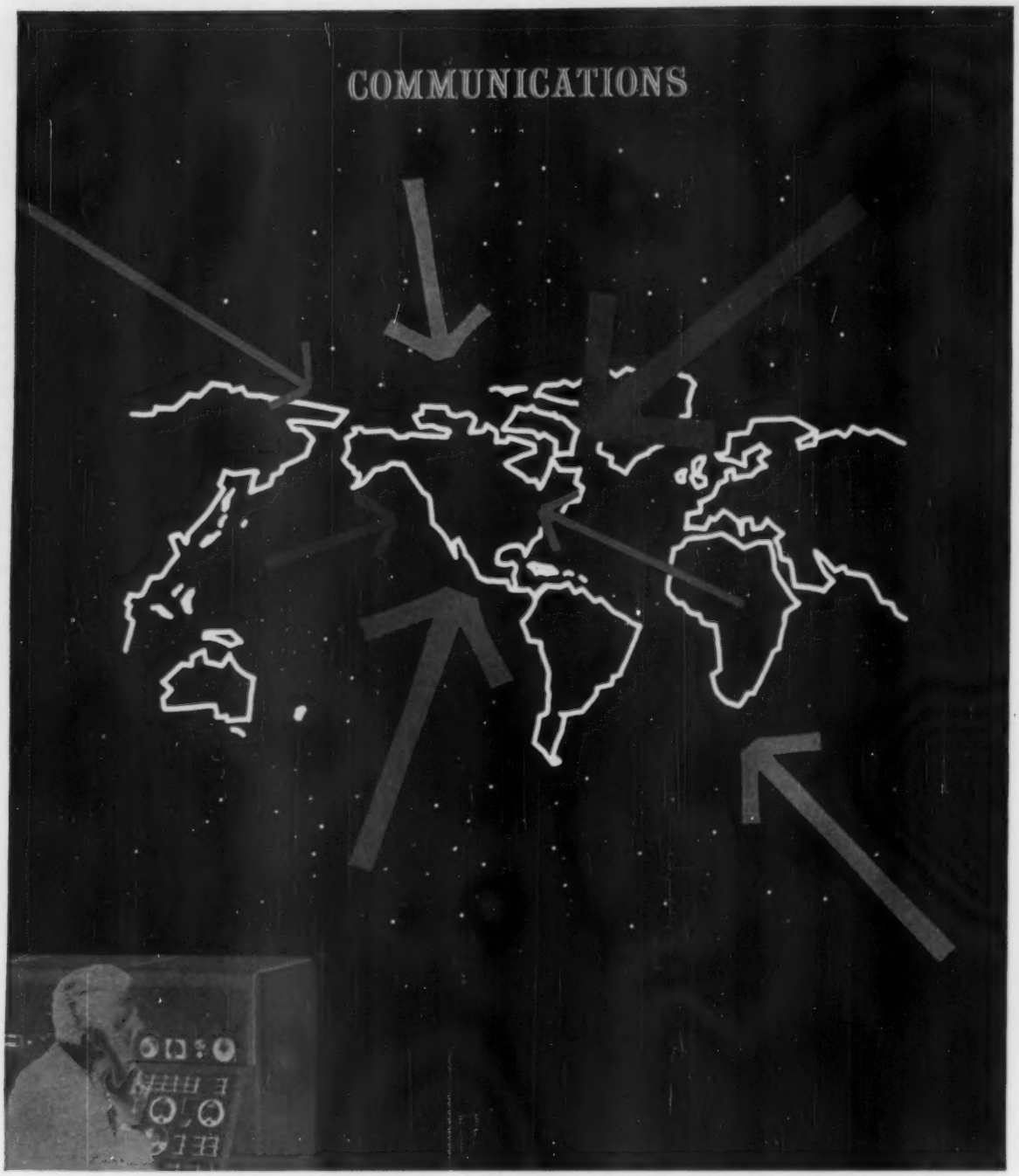
European observers believe that an order for at least 200 airplanes would be necessary to justify setting the project in motion beyond the study stage. There is not much likelihood of finding that large a market for a single design in the entire world, let alone Europe, which was the primary target for the HFB-314 project. What market will exist in this special category will be contested by a half-dozen manufacturers of jet transports with much more experience behind them.

As presently projected, the HFB-314 is little more than a slightly faster Caravelle, and by the time it could be available for service in four or five years, the Sud-Douglas combine, among others, would have at least an equivalent—if not superior—airplane to offer customers.

Another practical objection to extending the HFB-314 project is the current and planned capacity of the German industry. Most observers here believe the industry has enough to do during the next four years without diluting it any further with a new and relatively unnecessary project.

The HFB-314 design was one of two selected by the West German Ministry from a group of study projects prepared by industry design teams for short- and medium-range transports. The other Ministry choice was a Heinkel twin-turboprop short-range transport in the Douglas DC-3 replacement category. The Heinkel design appears to be dormant, and only the Hamburger airplane is being widely touted.

The HFB-314 project grew out of the company's continuing interest in large transport aircraft. A number of design variations of the 314 transport were studied and the final configuration was developed about a year ago. Since then, the company has been trying to interest airlines, but the extent of its success is not known.



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Cost Increases

Specific areas where Eastern Air Lines showed cost increases that resulted in a deficit of $640,039 for the first quarter of 1960 compared with a $2,101,859 profit for the same period last year were described by Chairman Edward V. Rickenbacker to the Security Analysts.

Expenses rose 20% over-all to total $77,710,343 as against revenues which rose to $77,284,417 from $70,460,076 last year. The breakdown, which clearly showed the effect of transition to the Lockheed Electra and Douglas DC-8:

Item	Increase
Training	48%
Parts and supplies	54%
Overtime (including holiday pay required by training programs)	62%
Depreciation	39%

Rickenbacker said fuel costs had declined slightly because of the greater use of less expensive kerosene for turbine engines, but he said he doubted whether this price difference would remain in effect long.

Four areas are primarily responsible for increasing costs, he said: depreciation charges, interest, rising insurance rates on turbine equipment, and wages.

the crash and experienced little or no turbulence, he said.

His comments on the integration of transportation systems came during a discussion of the long range future of the airlines in which he pointed out that perhaps the time had come now to look at transportation as a whole, rather than dealing with rail, air and steamship problems as separate.

A basic advantage might exist, he felt, in integrating domestic trunk airlines and railroads or international airlines and shipping companies—not necessarily by merger but through stock participation. As air cargo expands, airlines will have to duplicate at great cost handling systems already in existence for railroads or shipping. Integration would obviate this duplication.

As for merger, he said Eastern is interested in gaining two things—earning power and leadership. "If we can get both, we're interested," he said, "and we might be willing to let the other fellow take the lead."

April produced some "real sunshine" when system load factors rose to 58%, he said, and he felt this trend would continue. Eastern is basing its request for a fare increase under the new rate of return concept on a 60% load factor, which he indicated would be an excellent over-all average for Eastern's predominantly short-haul routes.

DC-8 load factors have run at 80%, he said. On the Electra, prior to the Tell City accident Mar. 17, they were running 57.60%. From Mar. 18-31 they ran 53.44% and for the month of April, 52.34% Rickenbacker said this latter figure was a good average since load factors for the first two weeks of the month were in the low 40s.

Rickenbacker was highly critical of CAB-recommended accounting changes, on residual values of piston equipment, for example. "We had to increase their residual value to 15% from 5% when we should have written them down to nothing because that is what nature is doing to them now," he said.

Jet aircraft may face the same problem, he added, for much can happen in the next 10 years over which this equipment is being written off. He said the maximum depreciation period for a jet transport should be five years. He also felt deferring of some jet transition costs and of interest charges on funds borrowed for progress payments were wrongfully encouraged by the CAB. "It's fundamentally not good business," he said. "When I spend money, I like to charge it off."

Eastern in 1959 deferred $1,927,000 in transition costs and $411,000 in interest costs for amortization over a period of years. Combined with a change in computing deferred income taxes, Eastern's 1959 net income was $3,050,000 higher than it would have been under previous accounting methods.

Britannia Crash Cause Undetermined

London—Precise cause of a crash of Bristol Britannia G-ANCA Nov. 6, 1957, at Downend, Bristol, cannot be determined, British Ministry of Aviation said in its official investigation report last week.

The report stated: "The accident was the result of the aircraft developing a very steep descending turn to the right which the pilot was unable to control. The reason for this could not be determined, but the possibility that it occurred as a result of a malfunctioning of the autopilot cannot be dismissed."

Investigators cited a design fault in the electrical circuitry. Similarity of the accident to another incident involving a Britannia, in which recovery was made only after autopilot power was isolated, was noted. Same fault was evident in both cases, the report said.

Report was contested by Smiths Aviation Division, autopilot manufacturer, which argued that damaged condition of components could still be consistent with damage due to the crash.

The report concluded that the autopilot failed to disconnect although proper switches had been activated and that a force-limiting link had sheared before impact.

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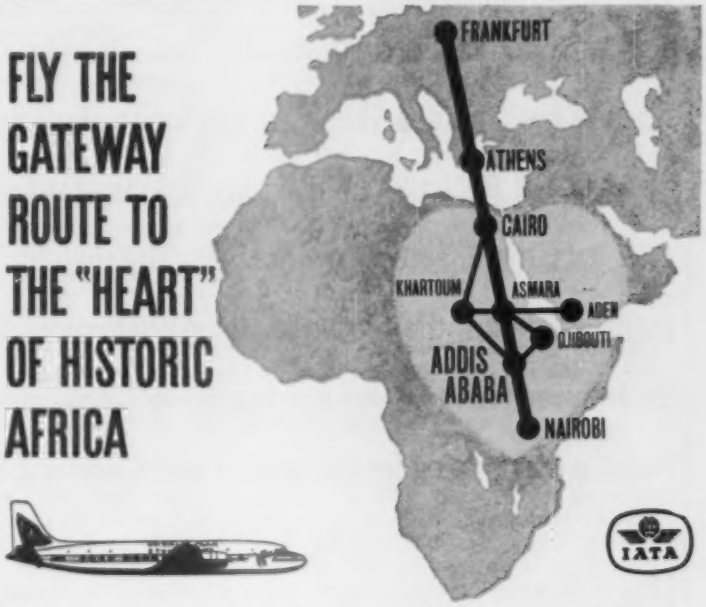

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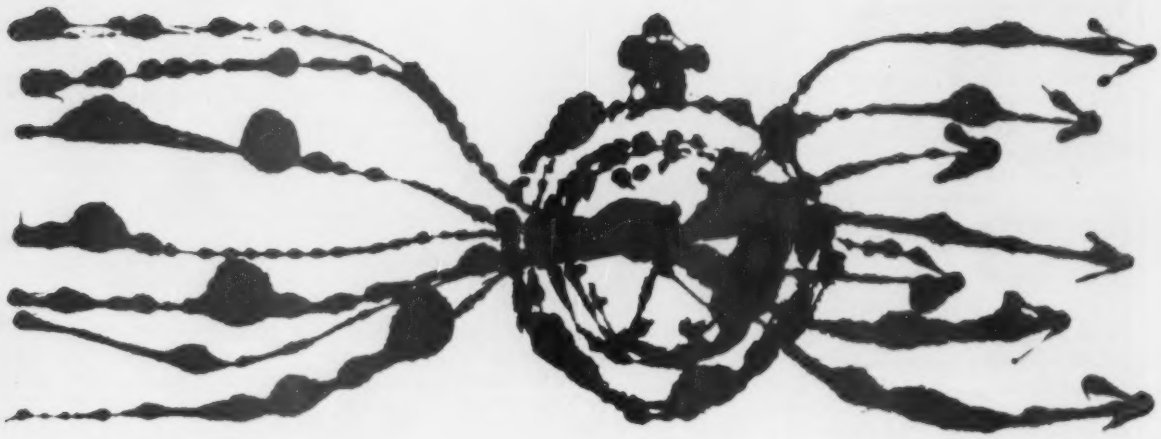

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SHORTLINES

▶ **Alitalia**, the Italian airline, has accepted delivery of the first of its fleet of six Douglas DC-8 turbojet transports —a Series 40 model powered by Rolls-Royce Conway bypass engines. As of Apr. 28, 47 DC-8s had been delivered. Alitalia was the 11th airline to accept delivery.

▶ **Allegheny Airlines** is consolidating its sales and service management under the direction of L. T. Ferguson as general sales manager and Robert C. Schumm as general manager-transportation services. Reason for the consolidation ". . . is based on a concept of 'sales through service'."

▶ **Continental Airlines** is adding five Boeing 707 passenger-cargo flights on its Chicago-Denver-Los Angeles routes this month, increasing its jet air freight capacity to 300,000 lb., a gain of 30%.

▶ **KLM Royal Dutch Airlines** reports $4.2 million net earnings for the 12-month period ending Mar. 31, a gain of $3.2 million over the previous 12-month period. The carrier, however, has reported a net loss of $2.2 million for the first quarter of 1960 despite an increase in operating revenues—which climbed 14% above the same period of last year to $30.6 million.

▶ **Southern Airways** is planning a new administration building at Atlanta Airport, with occupancy scheduled by the end of the year. Building will house the airline's sales, operations, treasury and administrative departments.

▶ **Trans World Airlines** has received a Civil Aeronautics Board exemption from the Federal Aviation Act permitting the carrier to serve points in Georgia and Florida from the West Coast so long as the carrier does not provide through-plane service. The Board's exemption said in part that TWA may serve Miami, Tampa/St. Petersburg/Clearwater and Atlanta ". . . only on flights terminating or originating at Nashville, Tenn., or St. Louis, Mo."

▶ **United Air Lines** reports that it is hiring an additional 500 mechanics, ground personnel and administrative workers to service its expanding turbojet fleet. By the end of 1960, United expects to have 33 Douglas DC-8s and 11 Boeing 720s. In 1961, the carrier hopes to add seven more of each type as well as one Douglas-produced Sud Caravelle. The airline also plans to hire an additional 700 stewardesses this year.

AIRLINE OBSERVER

▶ **Continental Airlines President Robert F. Six is urging Congress to underwrite development costs of a supersonic transport aircraft. In a letter to the House Science and Astronautics Committee, the airline executive estimated that a prototype Mach 3 to Mach 3.5 aircraft could be developed for $100 million and said the government could eventually recoup development costs by levying royalties on all production aircraft. He points out that the British government financed the Vickers Viscount in the same manner.**

▶ Third-pilot battle between the Flight Engineers International Assn. and the Air Line Pilots Assn. may be prolonged as a result of current contract talks between FEIA and Eastern Air Lines. Engineers are now demanding that wherever Eastern uses a three-pilot crew, two flight engineers should be utilized.

▶ **United States and British aviation manufacturers do not plan to appeal the International Air Transport Assn. ban on their attendance at IATA's annual general meeting in Copenhagen in September, but French aviation manufacturers are pressing to attend on a semi-official basis. Scandinavian Airlines System, the host airline, has indicated that it does not want manufacturers present, and IATA's executive committee is not expected to rescind the ban voted last fall in Tokyo.**

▶ Newark Airport may receive its first scheduled jet service this summer with the inauguration of Convair 880 flights by Delta Air Lines. Publication of the airline's summer schedule apparently is awaiting Port of New York Authority approval of jet service into Newark. Approval would probably permit Delta to provide the service sometime in July. Meanwhile, Delta plans to begin 880 schedules between Memphis, Chicago and New Orleans on July 1.

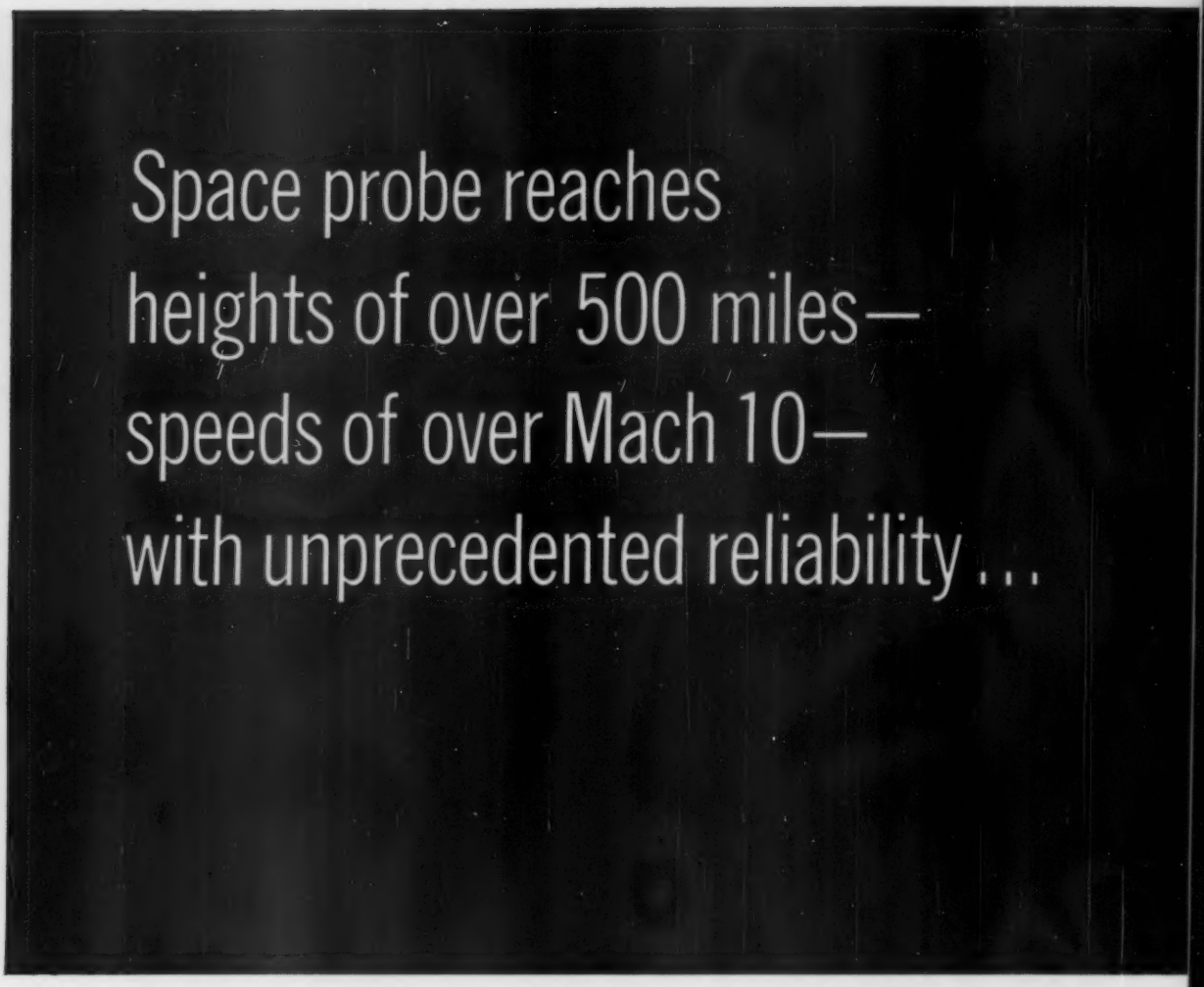
▶ **North Central Airlines plans to purchase an additional five Convair 340s this year and expects to expand its Convair fleet at approximately this rate for the next several years. However, there are no plans to convert the aircraft to turboprop configurations for at least three years, the airline reports.**

▶ Pan American World Airways' pilots were enjoined by Federal Court order last week not to refuse flights that might involve more than 8 hr. of duty time in any 24-hr. period. Restraining order, issued by Judge Emett C. Choate in Miami, Fla., against the Air Line Pilots Assn., found that ALPA efforts to prevent the pilots from accepting such flights constituted illegal interference with the airline's business and employment contract which does not expire until Aug. 24. No date was set for a further hearing.

▶ **Flight Engineers International Assn. officers and 39 FEIA members at Continental Airlines are being sued as individuals by the airline. Complaint filed by the airline in Federal District Court of Los Angeles charges that telephone ticket sales dropped from a high of 500 calls to 150 a day following the union's recent public threats to strike the carrier.**

▶ Federal Aviation Agency moved last week to extend positive control of aircraft along three transcontinental airways from the present upper limit of 22,000 ft. to 35,000 ft. in the long-range radar-controlled area of Chicago-Indianapolis. Lower limit would remain at 17,000 ft. Under a proposed regulation amendment scheduled to go into effect by Oct. 15, aircraft operations in the control area would require aircraft to be equipped with radar beacon transponders as an identification aid plus radio equipment tuned to a specific frequency providing direct communication between pilot and controller.

▶ **British Overseas Airways Corp. will cut its round-trip New York-Nassau fares from $143.10 to $122.60 on May 22. New fare applies to BOAC's 30-day round-trip tourist class excursion for summer and autumn months and expires Dec. 15.**



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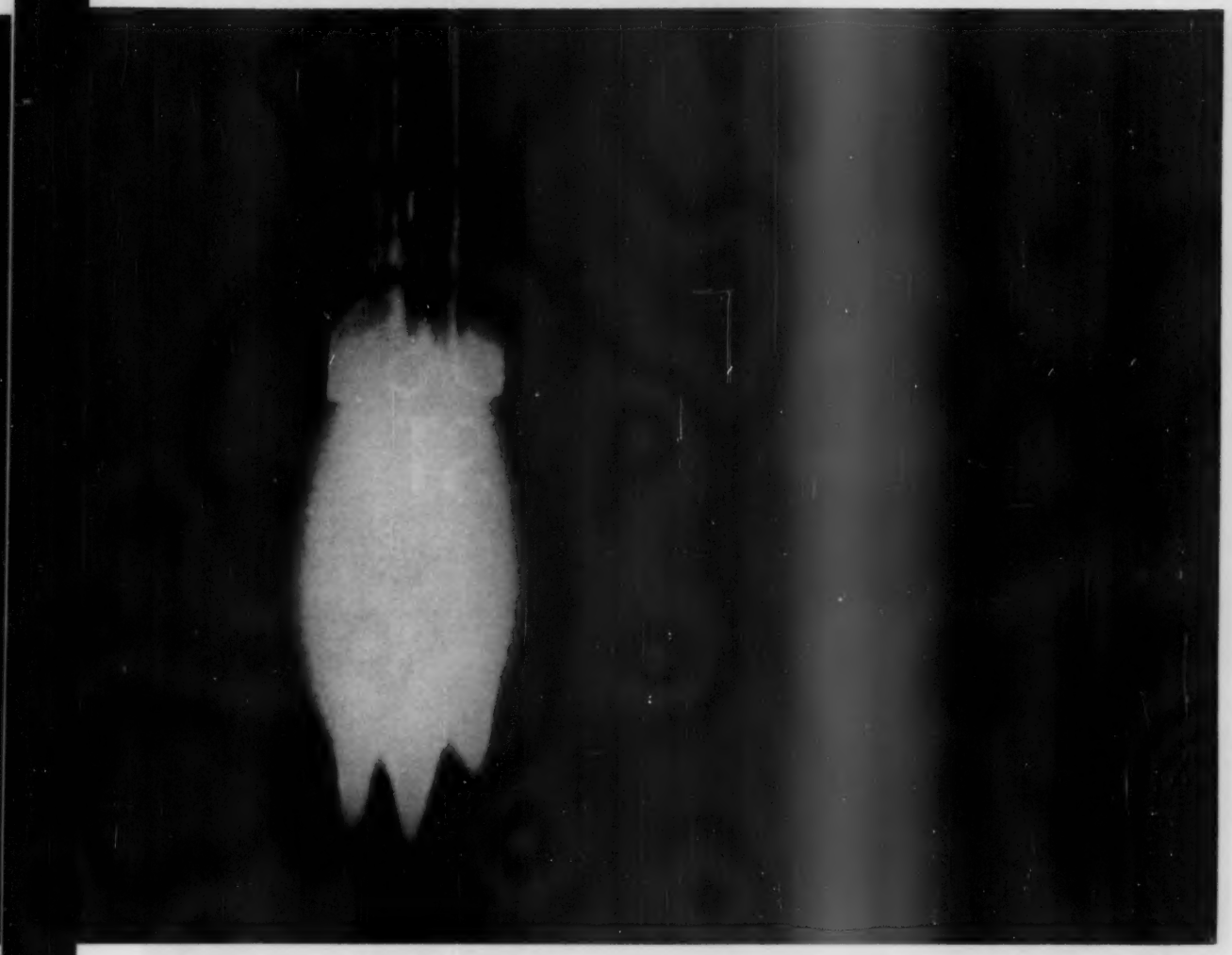

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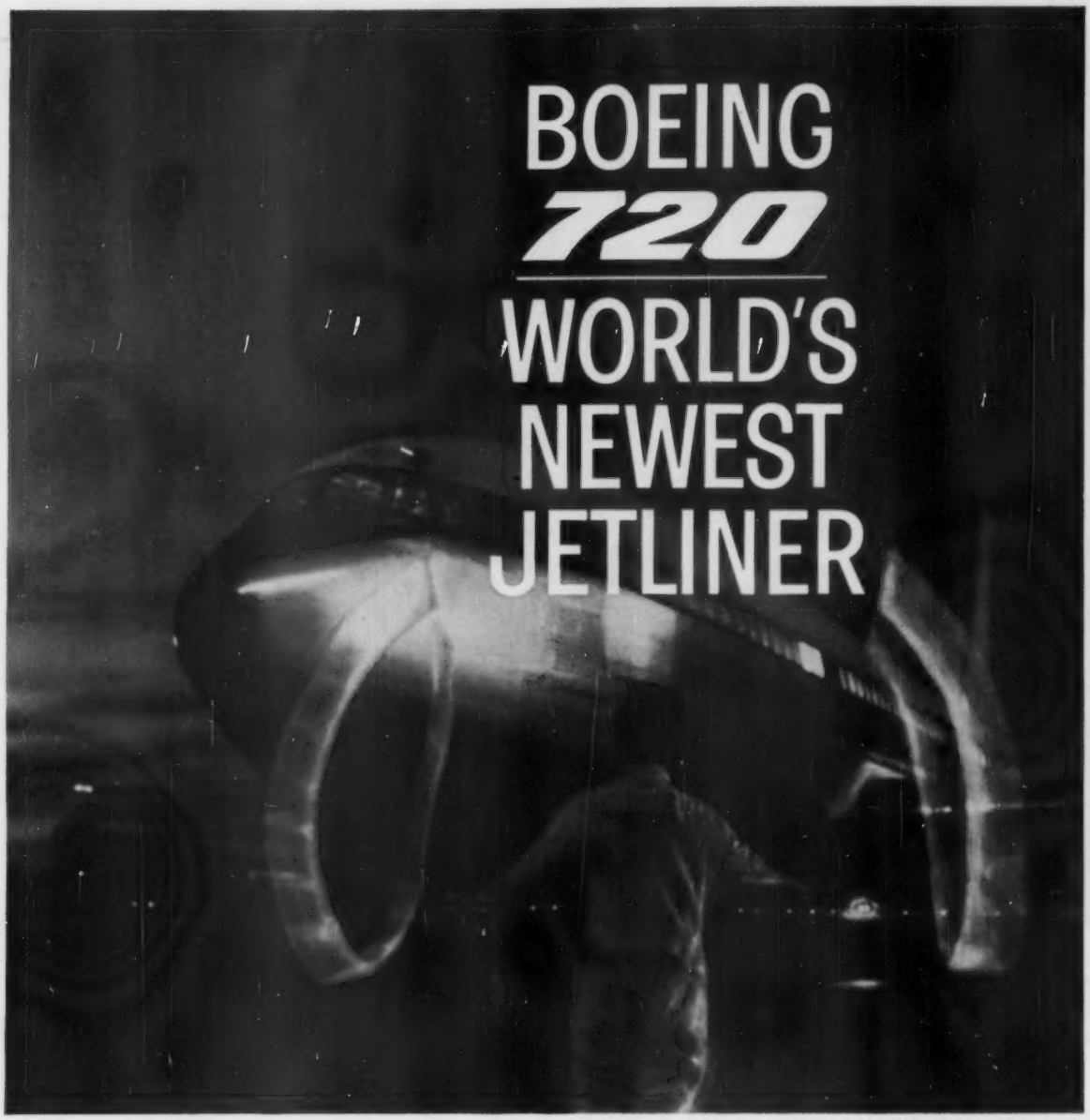
The Bristol Siddeley Orpheus, the world's most advanced lightweight turbojet engine, powers this Fiat G 91, NATO standard lightweight strike fighter. The Orpheus is in service in six different aircraft and is specified for eight others.

The Bristol Siddeley Proteus powers the Britannia airliner. Four Proteus give this 130-seat aeroplane a speed of over 400 mph—a range of over 5,000 miles. Britannias are in service with twelve airlines and with RAF Transport Command.



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First of four Sud Caravelle Mk. 1s is delivered to Swissair. Aircraft is powered by two Rolls-Royce Avon Mk. 522 turbojets, rated at 10,500 lb. sea level static thrust each.

Caravelle Versions Include Fan Engines

New growth version of General Electric CJ-805-21 aft-fan engine, the CJ-805-23, with takeoff thrust rating of 16,100 lb., will be fitted to Sud Caravelle Mk. 7 jet transport purchased by GE for testbed use (AW May 2, p.119). Program is aimed at speeding FAA certification of the aft-fan Caravelle, which will be sold by both Sud and Douglas Aircraft Co. Configuration of the short-cowled aft-fan engines is shown on model. Five engine cowls, pods and stubs will be produced by Douglas for the first CJ-805-23s. Douglas will deliver these assemblies under a $1.2 million contract in November. Specifications of Caravelle Mk. 7 indicate a maximum cruise speed of 540 mph. and range of 2,000 mi.

Alitalia has four Caravelle Mk. 3s on order; first is shown above and is fitted with noise suppressors on tailpipes. Powerplants are Rolls-Royce Avon Mk. 527s of 11,700 lb. thrust.

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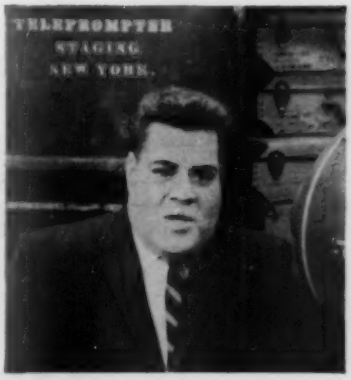

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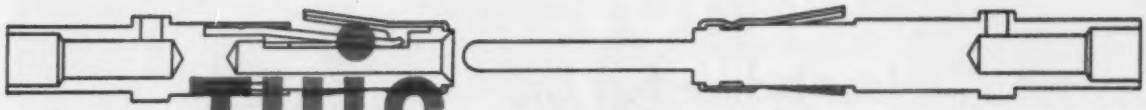

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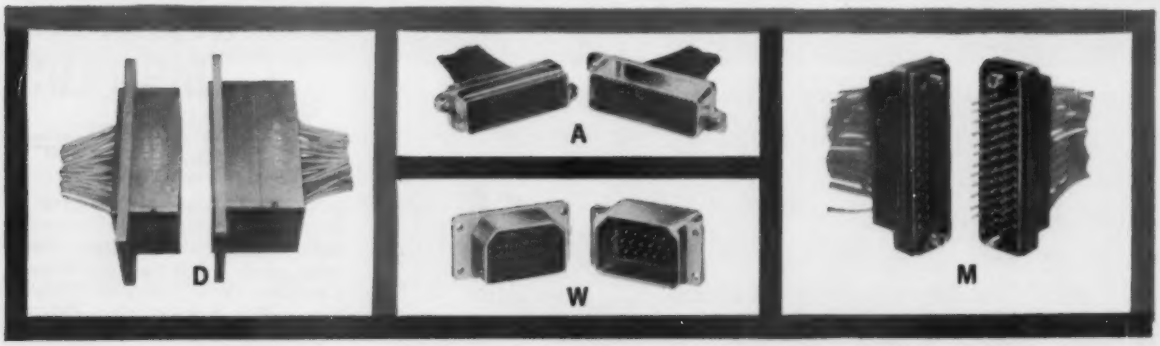

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Component Reliability Practices Proposed

By Philip J. Klass

Washington—Specific measures for improving the quality and reliability of electronic components and slashing the time required to prepare and bring up to date military specifications will be available to industry within 60 days.

First details of the measures, the result of a two-year Defense Department-industry study, were disclosed here at the Electronic Components Conference.

The recommendations, if implemented by the Defense Department, could have a profound effect on producers of electronic components, manufacturers of defense electronic equipment and upon the using military services.

Here are some of the new practices recommended by the Ad Hoc Study Group on Parts Specification Management for Reliability:

• **Reliability level** of electronic components will be spelled out in military specifications, along with tests which must be performed by the component maker to assure that components meet specified reliability levels. There will be five different reliability levels, expressed in failure rate per 1,000 hr.: 0.001%, 0.01%, 0.1% and X%, where the latter figure depends upon the specific component type.

• **Qualification approval** would not be given to a new component solely on the basis of tests of a few hand-made samples, as in the past. Instead, component makers will be required to submit to a central defense agency all data from acceptance tests performed on subsequent production. If production units exhibit a higher failure rate than original samples, the manufacturer will be delisted, or shown as a source only for lower-reliability components. If, however, subsequent production exhibits a lower failure rate than early samples, then the manufacturer can request a new listing as a supplier of higher-reliability component.

• **Component manufacturers** would be required to provide their customers with acceptance test data which has been certified by a responsible company official.

• **Permanent advisory group,** reporting to the Assistant Secretary of Defense for Supply and Logistics, is recommended to carry out the new program, to coordinate and speed up the preparation and revision of military component specifications, and to serve as a central information exchange agency to collect and disseminate data to and from industry and the military on component failures and component application information.

After a two-year study, the ad hoc committee, headed by Paul S. Darnell of Bell Telephone Laboratories, con-

Soviet Trawler Photographed in U.S. Test-Firing Area

Soviet trawler Vega, equipped with tracking radar and probably sonar equipment, was recently photographed by a U. S. Naval patrol plane about 60 mi. south of Long Island, N. Y., near an area where the Polaris submarine George Washington was test-firing dummy missiles. Secondary mission of the trawler apparently was to gain information on the George Washington's speed, screw noise, etc. Primary mission, however, is believed to have been the monitoring of U. S. radar and communications frequencies. Visible systems include X- or K-band radar tracking antennas and a direction finding antenna located on the superstructure above the bridge; communications antennas are strung between two masts.

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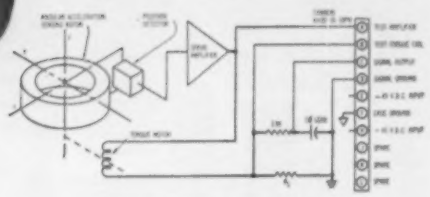
Chief applications for this unique force balance angular accelerometer are closing the servo loop on ground launching equipment for missiles and detecting the roll, pitch and yaw accelerations of missiles once they are airborne. In the latter application, the Model 4525 can replace some gyros and supplement others.



Operational diagram of Donner's new Model 4525 Angular Accelerometer.

Donner's rugged new angular accelerometer weighs only 2 pounds.

The Specs

RANGES AVAILABLE
From ±1 radian/sec² to ±50 rad/sec² to any intermediate range.
FREQUENCY RESPONSES
±1 rad/sec² 30 cps natural frequency (90° lag)
±10 rad/sec² 100 cps natural frequency (90° lag)
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±20 volts across a 12,500 ohm load
RESOLUTION 0.01% full scale or better
LINEARITY 0.1% full scale
HYSTERESIS Less than 0.01% full scale
DAMPING 0.6 ± 0.1 of critical
SIZE 3.7" diameter x 3.7" high
WEIGHT 2 pounds

The mechanically rugged and electronically rigid Model 4525 is one more basic technical contribution from an engineering team specializing in inertial systems interlocking time, acceleration, velocity, and other dynamic inputs.

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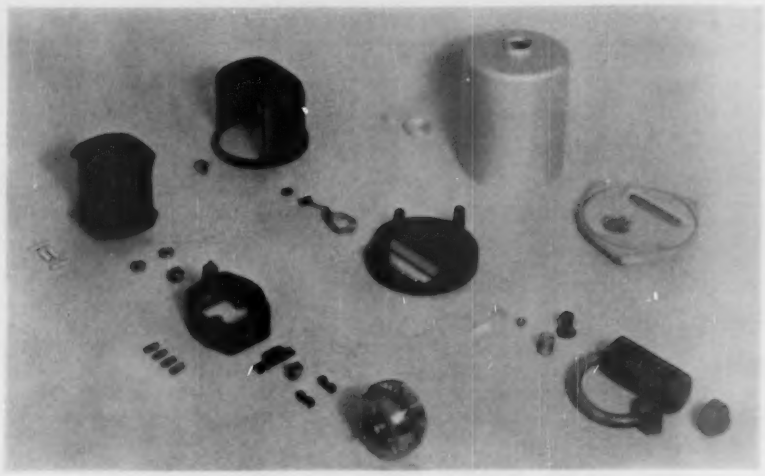

Lear Develops Gas-Driven Gyro

Gas-driven gyro for missiles with short flight time, developed by Lear, Inc., uses either a solid- or liquid-fuel cartridge, electrically ignited, to drive turbine wheel at 12,000 rpm. The two-degree-of-freedom gyro provides 360 deg. freedom about outer gimbal and ±75 deg. about inner gimbal. With an angular momentum of two million, Lear says gyro drift rate is 0.125 deg./min. about outer gimbal and 5 deg./min. maximum about inner gimbal when subjected to high roll rate. Gyro is uncaged electrically and comes up to speed in about 0.1 sec. It can be operated at ambient temperature of −65 to 165F. The hermetically sealed gyro weighs 3½ lb., measures 4¼ in. dia x 5½ in. long. Exploded view above shows relatively few parts in the new Model 1090-C gyro.

cluded that military specifications have failed to provide equipment manufacturers with up-to-date reliable components because of the lack of effort or suitable organization in DOD and in the three military services.

"The military services have considered parts specifications and standardization programs only as part-time efforts and have not given them the status, attention and resources they deserve in view of the tremendous dollar savings and greater reliability they could make possible," the report says.

Because of the difficulty of getting agreement between the three services, it sometimes takes 18 months to work out a jointly acceptable military specification. By this time, the component described in the specification frequently has been outmoded by a new development.

The report therefore recommends the formation of a permanent Advisory Group on Management of Electronic Parts Specifications (AGMEPS), consisting of representatives of interested agencies in the Office of the Secretary of Defense, the three military services and industry.

The proposed group would report to the Assistant Secretary of Defense for Supply and Logistics. Its function would be to review all Defense Department programs for parts specification management and make recommendations on detailed decisions for implementing the program recommended by the ad hoc group.

Approval of a new specification would require only a majority vote, not unanimous approval of the three services as in the past, according to the recommendations.

Responsibility for preparing military specifications presently is assigned to the Armed Services Electro-Standards Agency, but it is jointly financed by the three services and does not report to a single "boss" in the Defense Department.

Although the original intent of Qualification Approval Listing (QPL) was to provide equipment manufacturers with a list of suppliers who can provide acceptable items with minimum delay, the present qualification procedure merely shows that listed companies once manufactured a handful of components which passed the QPL tests. As a result, QPL has little value to an equipment manufacturer.

He must conduct his own tests to determine the present reliability and quality of the supplier's current production.

Under the proposed recommendation, component manufacturers would, in addition to submitting initial samples for qualification tests, be required also to provide:

- **Evidence of satisfactory production,** test facilities and sound process and quality control practices.
- **Sufficient test data** on production quantities manufactured over an extended period to establish, within prescribed confidence limits, that the com-

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the new data processing system with the ORGANIZATION CHART *concept*

"Organization Chart" design in the Bendix G-20 means far faster, more efficient processing of scientific and business problems. The reason is clear:

The electronic manager of every data processing system is a computer. But most are poor "bosses" because they cannot delegate authority, or even supervise more than one operation at a time. Many computers run operations as complex as your own business, but with an inefficiency that you would never tolerate. Bendix engineers saw this shortcoming, and turned for a solution to the organization chart common to any well-managed business.

The G-20 Central Processor, or computer, has a staff of well-taught subordinates that can take instructions from the "boss" and go to work on their own, directing the workers that perform such tasks as reading punched paper tape and cards, looking up data on magnetic tape, and printing results. The "boss" can direct numerous subordinates, and without human intervention, schedule the work for each, making sure the most important work is done first. While the subordinates handle the details, the Central Processor is free to do the all-important computing.

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SPECIFICATIONS:

MEMORY: Core, to 32,768 words in 4096 word modules.

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EXECUTE ×: 49 μs. avg., fixed point, one-word precision. 49 μs. avg., floating point, one-word precision.

ARITHMETIC: Built-in floating pt., 12 dec. digit precision.

CIRCUITRY: Solid-state; parallel; 2.5 kva.

PROGRAMMING: Symbolic assembler or algebraic compiler.

INPUT/OUTPUT: 165,000 char./second max., asynchronous.

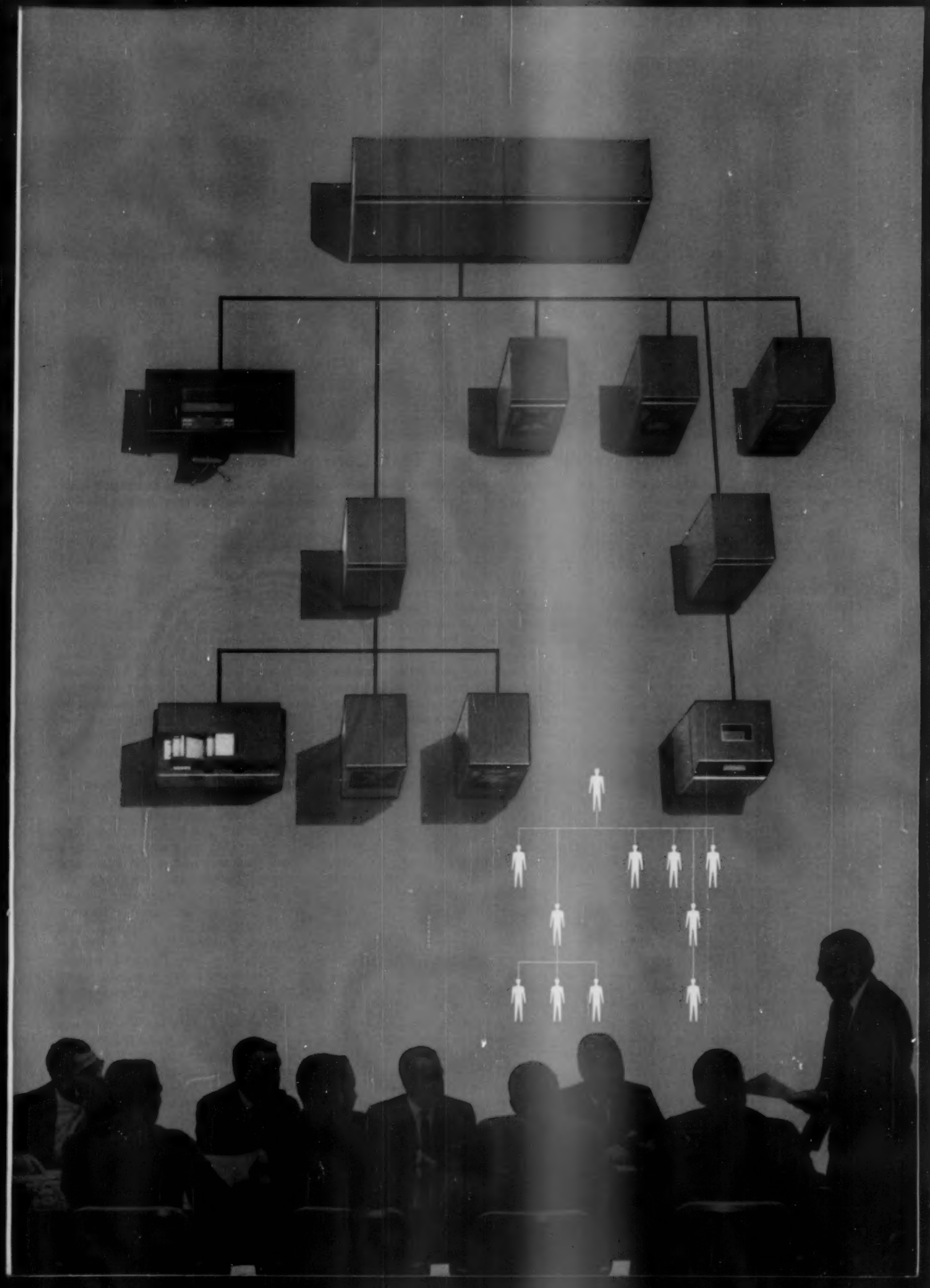
MAGNETIC TAPE: 120,000 decimal digit/second read-write.

LINE PRINTERS: 600 lines per minute.

PUNCHED TAPE: 500 or more character/second readers. 100 or more character/second punches.

PUNCHED CARDS: Standard high-speed 80 column units.

CONTROL BUFFERS: 1024 character memory for data and commands. Controls transmission on-line or off-line.



Strategic Air Command Test Control Bank

Strategic Air Command test control bank (left), part of a prototype system now under development, checks functions of computers and data processing units at Paramus, N. J. At right is a model of the prototype automatic control center. Both are being built at Paramus by International Telephone & Telegraph Co.

ponent's failure rate equals or is lower than maximum established by specification.

• **Continuing test data,** collected during acceptance tests of subsequent production on a continuing basis, to enable the central agency to determine whether a supplier's components still meet the original failure rate, whether he must forfeit listing or can be advanced to a higher reliability level listing.

• **Notice of change in design** of component, materials or processes used in its manufacture, to enable the central agency to determine whether a company's component reliability rating must be re-evaluated.

To reflect the revised nature of qualification approval, it is recommended that the name be changed to "Approved Sources of Supply for Qualified Electronic Items List."

The ad hoc committee report recommends practices which are intended to relieve equipment manufacturers of some of the extensive component testing that many now perform, but are not intended to relieve the equipment manufacturer of the prime responsibility for component quality and reliability. The report acknowledges that it is too expensive for each equipment manufacturer to station its own inspectors at each of its component suppliers' factories to assure that tests are performed according to specification and that the test data is factual.

It is therefore recommended that all military specifications require the component manufacturers to provide test data on parts supplied, with certification of such data by a responsible official of the manufacturer.

Increased use of government inspectors at component manufacturers' plants also is recommended. These would be used not only for direct purchases by the government, but also to verify inspection procedures where equipment manufacturers wish to delegate responsibility for quality assurance to the component manufacturer. Government inspectors also would conduct audits of manufacturers' facilities, quality control programs and make spot checks of outgoing product quality to determine conformance with military specifications.

A survey of 25 equipment manufacturers and 20 parts manufacturers by one of the subgroups in the ad hoc committee revealed that today only about 50% of all parts are purchased to military specifications and that government source inspection is requested on approximately 35% of all parts other than tubes or semiconductors on which government source inspection is mandatory for devices sold to military specifications. The survey indicated "an almost overwhelming response . . . for the introduction of in-plant qualification approval testing under the supervision of the government inspector," the report says.

Another subgroup of the ad hoc committee recommends the establishment of a central organization in the Defense Department to collect technical information on basic component failure rates and component application data from industry and the military services for dissemination to industry and military designers. Efforts by industry to exchange such data have not been too effective because of fear of legal entanglements, the report says.

The report questions, however, whether such a central government data exchange agency would greatly reduce the amount of component testing now carried on by individual manufacturers, unless recipients have confidence in the tests performed by others. For this reason, it calls for an effort to obtain greater standardization of test procedures among defense contractors.

The report also recommends that the military services standardize on one elapsed-time indicator and make its use mandatory, where feasible, on military electronic equipment.

The report also calls for new carefully controlled programs, manned by experienced technicians, to obtain and analyze failure-rate data for typical air, shipboard and ground-based equipments. Further, that such data be compared with that now obtained from Electronic Equipment Field Data Reporting System cards prepared by military maintenance personnel, to determine whether data from two sources can be correlated.

The detailed, two-volume report by the Ad Hoc Study Group on Parts Specification Management for Reliability, prepared under the sponsorship of the Office of the Director of Defense Research and Engineering and the Office of the Assistant Secretary of Defense (Supply and Logistics) now is being printed and is expected to become available at the Commerce Department's Office of Technical Services by late June or early July. Price has not been set.

Micromodules Pass Environmental Tests

By Barry Miller

Washington—Prototype micromodules containing a selective sampling of low-power level circuit functions have successfully withstood rigid environmental testing, it was reported here last week at the Electronic Components Conference.

The tested modules include a cross section of audio, radio frequency and digital type circuits which were subjected to a variety of tests covering environments which the modules might face in portable ground, vehicular, missile or satellite applications. A report, devoted to the status of the Army Signal Corps-Radio Corp. of America micromodule program, was prepared and presented by Don Mackey, of the Surface Communications Division of RCA in Camden, N. J.

The Army-RCA micromodule program is regarded as the most heavily funded service-supported effort in microminiaturization of components and systems. The Army's investment in this program swelled to beyond $15 million recently with an award of $8 million (AW May 2, p. 163).

As originally conceived, the Army program (AW June 9, 1958, p. 22; Apr. 13, 1959, p. 76) promised a ten-fold reduction in the size and weight of military electronic equipment and a comparable boost in reliability and maintainability. Size-weight objectives appear to have been met in prototype circuits; similar reliability and maintainability gains are somewhat more difficult to measure. The program has triggered, moreover, a vast effort among manufacturers to furnish components in suitable form factors for this and other high component density programs now emerging.

Cooperating with RCA as subcontractors are about 60 companies which supply materials and components for the program.

Micromodules are encapsulated stacks of 0.31 in. square wafers on which components, called micro elements, are mounted and then interconnected by 12 wires running through notches along the edges of the wafers. Aside from obvious space and weight economies, the program aims at a simple, mechanical production and assembly of the modules.

To date, the Signal Corps-RCA effort has concentrated on tactical field equipment such as the AN/PRC 34, a helmet radio transceiver, for which a complete micromodule receiver has been developed. A digital data processor, or 'high speed general purpose digital computer, about two cubic feet in size, weighing 35 lb. and containing about 2,000 micromodules of 16 different types, plus a memory, will be built under the latest funding to demonstrate micromodule capabilities. Separate from the Signal Corps effort, another RCA department recently developed an inertial guidance system which uses micromodules in one aspect of its construction.

Among the circuits already designed into micromodules are the RF and audio portions of a 50-mc. FM receiver. These include RF amplifier, mixer, crystal oscillator, IF amplifier, limiter, discriminator and audio amplifier. Digital circuits—binary divider, gate, pulse generator, time modulator, oscillator, clipper, pulse shaper, output amplifier—were fabricated for a time division multiplex receiver.

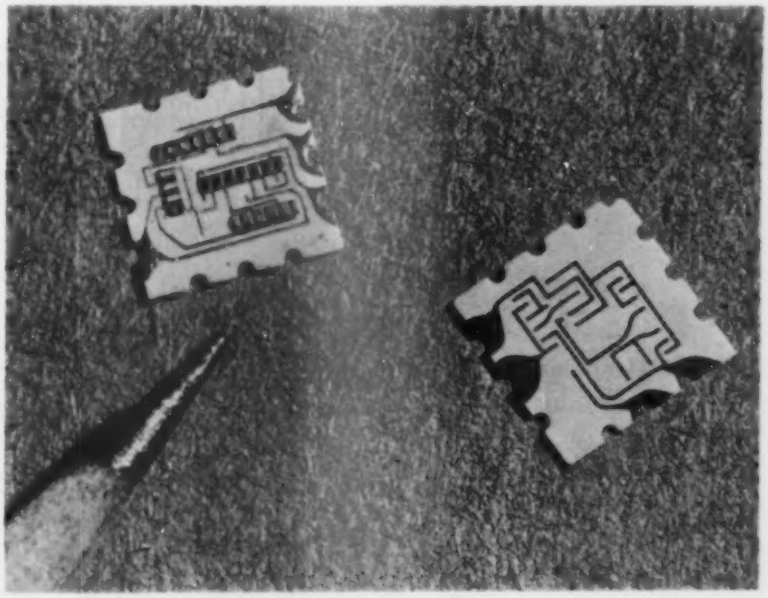
Environmental Tests

Environmental tests to which the modules have been exposed include temperature tests from −55 to 85C as well as vibration, altitude, shock, spin, storage, salt atmosphere and moisture resistance checks, according to Mackey.

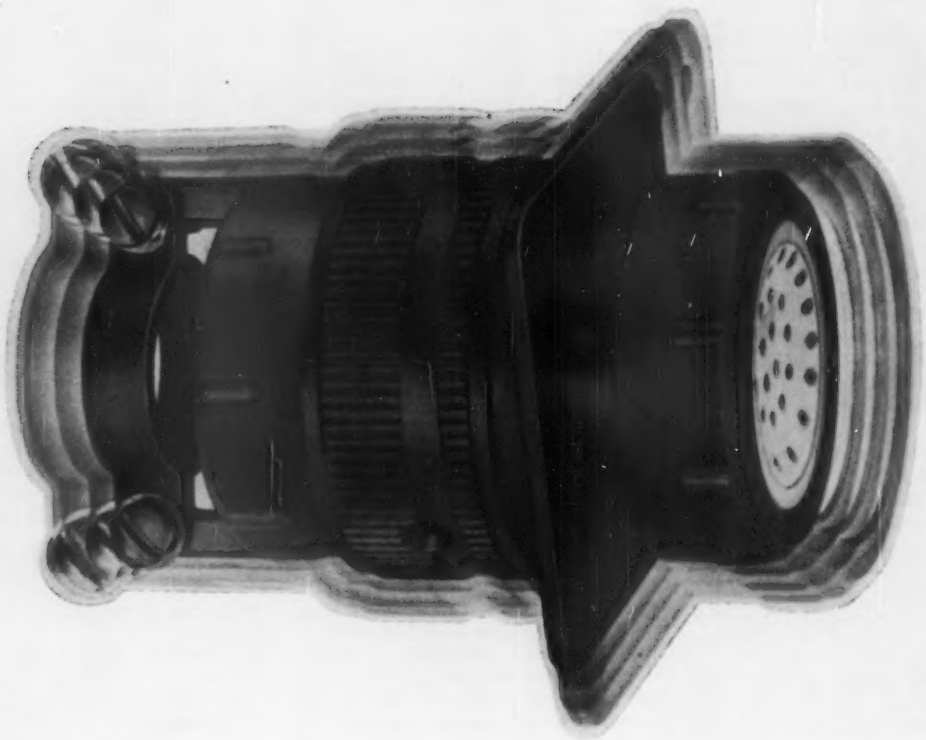
Performance of the module circuits has been comparable to that of conventionally constructed circuits. No fundamental limitations, Mackey indicates, were encountered in converting any of the previously mentioned circuits into micromodule form.

Among the micro elements—single or multiple components mounted on a single wafer—which have been developed by various firms for this program, the following are mentioned by Mackey:

- **Resistors**—Precision resistors (tolerances to within 1%), ranging in values from 10 ohms to 10 megohms, with up to four vacuum-deposited nickel chromium alloy units on a single substrate, are being made by Weston Instruments Division of Daystrom.
- **Inductors**—Wound on different types of ferrite cores, these inductors use toroidal form to minimize leakage fields and prevent spurious coupling to adjacent elements. Values up to 1,500 microhenries have been demonstrated. Precision transformers for 50-mc. RF circuits, 4.3-mc. IF circuits and RF chokes for filters were fabricated.
- **Diodes**—A family of Zener and reference diodes and small-size equivalents of 1N643 diffused silicon junction (Pacific Semiconductor) and 1N277 gold bonded (General Instruments) diodes were made available.
- **Crystals**—Seven to 70-mc. units were prepared.
- **Transistors**—RCA germanium 2N140, 2N404 and 2N384 and Philco 2N502A were repackaged for this program.
- **Capacitors**—Three types of capacitors were prepared by several firms, P. R. Mallory, Sprague Electric and RCA among them. Capacitors include tantalum electrolytics in value products up



ABILITY of Army-RCA micromodule wafer to physically accommodate molectronic techniques is illustrated by full binary adder using direct coupled unipolar transistor logic mounted on a single module wafer. Unit at right is covered by second wafer. Work was done by Sarnoff Research Center under contract to Air Force Cambridge Research Center.



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to 30 microfarad-volts (where the voltage rating can be selected during manufacturing), multilayer ceramic capacitors of different types.

Next step in micromodule progress will be the inclusion of several components on a single wafer, already demonstrated in principle with vacuum deposited resistors and a few other multi-element wafers.

Molectronic Techniques

Various solid-state or molectronic circuits are expected eventually to fit into the micromodule approach. These molectronic techniques are compatible rather than competitive with micromodules, Mackey believes. The micromodule can be the vehicle for these techniques, he says, because they lend themselves to the thin flat form factor of the micro element. Some of these all-solid state devices have already been mounted on single wafers to demonstrate this module capability. On one wafer, for example, RCA engineers placed a full adder, utilizing unipolar transistors and the integrated device concept of J. T. Wallmark of RCA Laboratories, Princeton, N. J.

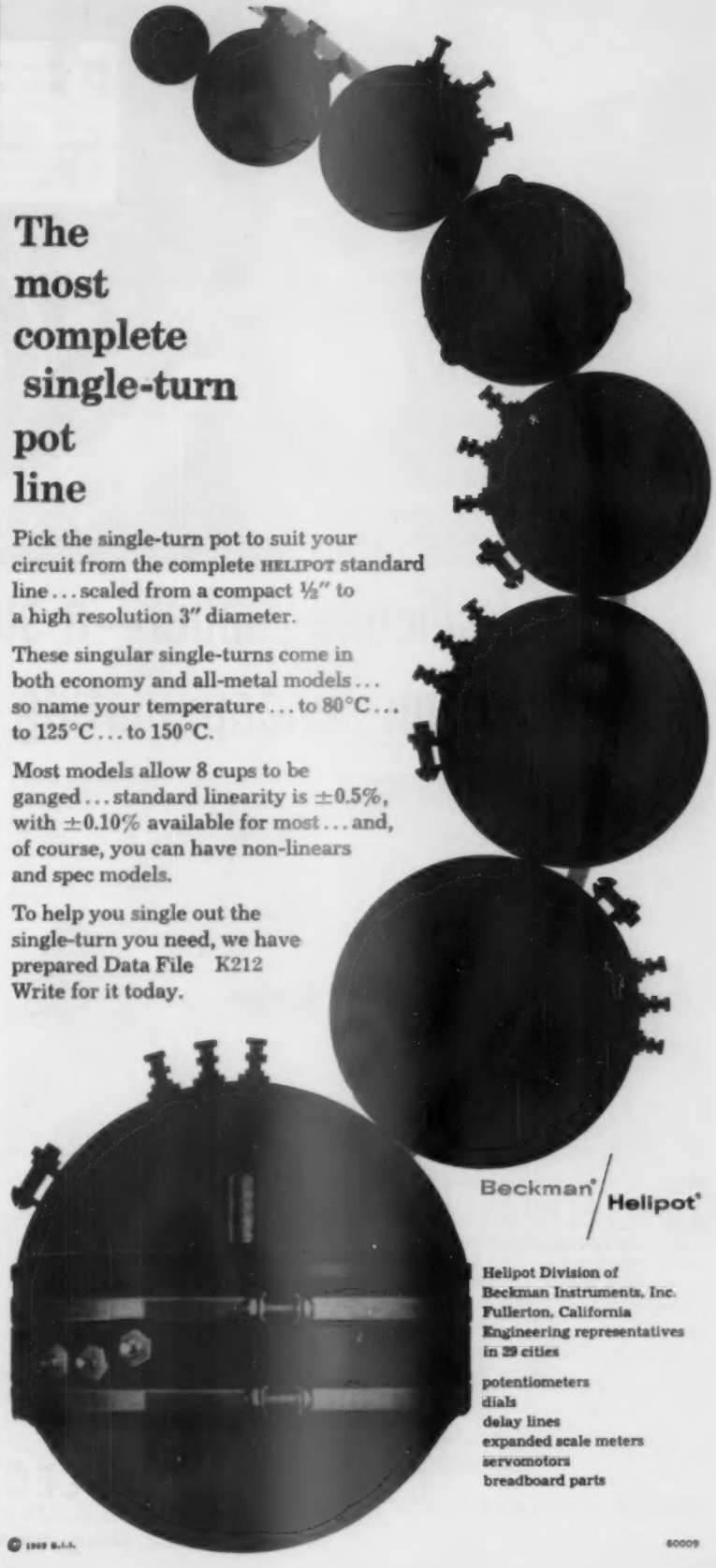
This single integrated circuit performs the function that is normally accomplished by 88 conventional components.

Transition to these new techniques and problems associated with their development and mastery will take time to overcome, and in the interval, molectronic devices will probably exist in hybrid combinations with conventional components, Mackey suggests. Solutions to specific circuit or system problems may involve an overlapping of several techniques, he points out, each superior to the other in some characteristic or application. In time, the single component wafer structure, now generally characteristic of early micromodules, will give way to multi-element or multi-function wafer modules whose functional capability is increased but whose appearance will be unchanged.

The first seven quarterly status reports on the progress of the micromodule program, dealing with the period up to the first of this year, are now available from the Office of Technical Services, Department of Commerce, and an eighth report, covering the first quarter of this year, is expected to be available shortly.

A byproduct of this program is the continuing trend toward repackaging standard transistors into smaller cases (AW Apr. 11, p. 94) so that the transistor's dimensions, especially its height, do not consume excessive space in any scheme for packaging components into subsystems.

One component packaging approach involving a smaller RCA 2N384 destined for micromodules was described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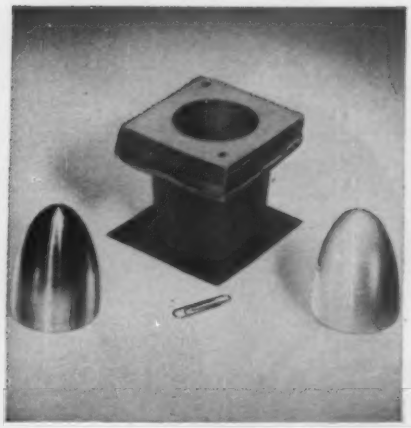
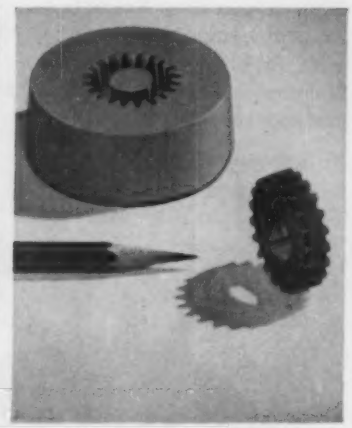


Prototype jet engine nose cone (right) cast in RTV mold. Epoxy parts cast in flexible RTV molds have a bright, glossy surface and reproduce extremely fine detail. No parting agent is required for even the most complex parts. High tensile and tear strength is retained even after prolonged heat aging.



Close-tolerance, non-standard helix gear cast complete in low-cost, one-piece RTV mold. Previously such replacement parts had to be machined by hand. Now they can be quickly and inexpensively replaced by using the broken part as a master.

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GENERAL ELECTRIC

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by Mackey. The transistor package, he explained, uses a recessed high density alumina substrate with holes for the connector exits at the bottom of the recess. Solder sealed weld pads are joined to terminal notches through conductor paths on the outer surface of the core. The transistor is dropped into the recess, its leads welded to the connectors, and a metal foil lid is soldered to a ring which has previously been placed around the recess to establish a hermetic enclosure. Ultrasonic energy does the cleaning, making solder flux unnecessary.

Philco Transistor Package

In another report at the conference, F. K. Clarke of Philco's Lansdale Tube Division reported on Philco's microminiature transistor package, which is designed to be suitable for multielement use on micromodule wafers. The package, Clarke says, can be inserted into a slot in the wafer and its leads will protrude horizontally, parallel to the wafer face, to simplify connections to other components on the wafer.

Over-all dimensions of the Philco package, as previously reported (AW Apr. 11, p. 94), are 180 mils in length, 125 mils width and 60 mils high.

In the Philco package a layer of glass separates a metal base plate and a rounded rectangular cup. Electrical connections to the semiconductor, Clarke explains, are provided by strips of metal, two mils thick, which are embedded in the glass. A top plate is then cold-welded to the package flange to hermetically seal the device.

Steps in the fabrication of the package described by Clarke are as follows:

- **Upper side** of the base and lower side of the cup are glass-coated.
- **Three flat** leads are bonded between the base and cap.
- **Excess material** is trimmed.
- **Semiconductor** is mounted in the package and the top plate is cold-welded to the flange.

Numbers of other avionic manufacturers are expected to reveal their approaches to the smaller transistor package during the remaining months of this year. Sylvania, for one, is understood to be on the verge of producing its germanium alloy pnp transistors in a microminiature pancake package, 250 mils in diameter and 50 mils tall. Contrasted with the Sylvania flat package dimensions are those of the "small" conventional TO18 case registered with the Electronic Industries Assn. at 170 to 210 mils in height, 209 mils in diameter.

Sylvania may design electrical equivalents of its pnip drift transistors, npn alloy transistors, and diffused base germanium and silicon mesa transistors into its new flat package.

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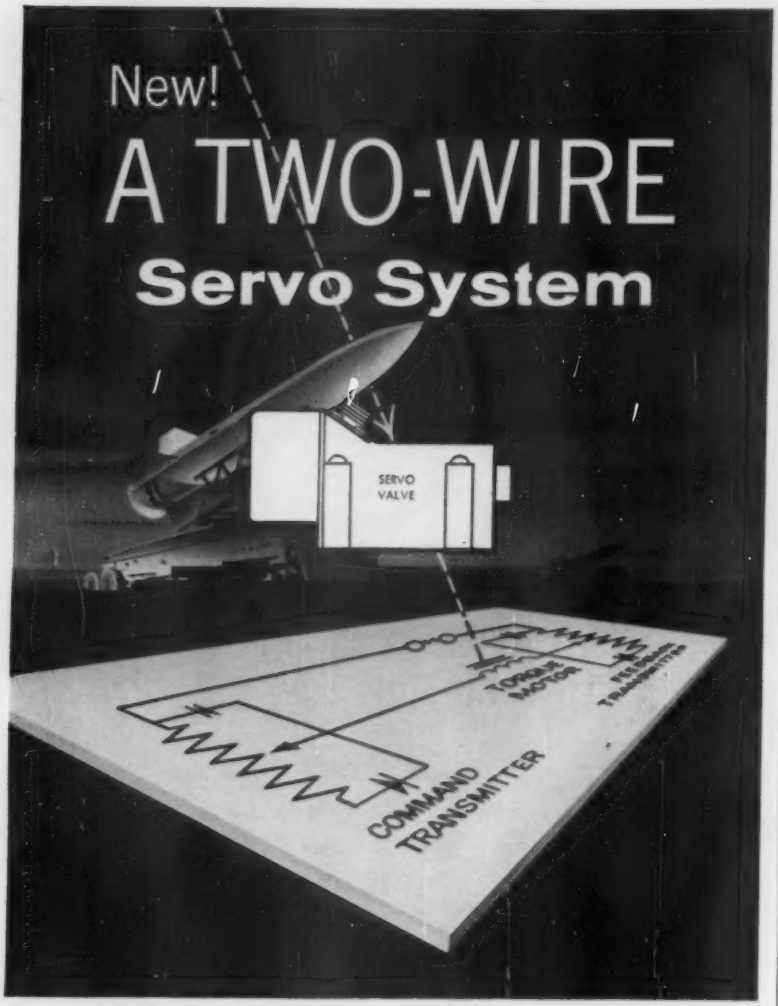

Fail-safe • A-C Excited • No Amplifiers

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Examine these features —

• **two wire transmission** — any short or open circuit will not cause an error signal calling for a "hard-over" response. Rather, the system remains fixed in its last position.

• **no electronic amplifiers** — the servo valve operates directly from the low-level output of the potentiometer.

• **weighs only 4 pounds** — simplified design and cartridge type plug-in components are easy to maintain and permit an exceptionally compact package.

Send for complete specifications on this advanced remote positioning system or outline your requirements and we will submit a proposal. Call or write, today.

Features

• unique two-wire error detector circuit
• no amplifiers
• 3,000 psi hydraulic actuation
• a-c excited — 60 cps, 400 cps or as required

CONSOLIDATED CONTROLS CORPORATION

A Member of The Condec Group

BETHEL, CONNECTICUT • INGLEWOOD, CALIFORNIA

FILTER CENTER

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NEW AVIONIC PRODUCTS

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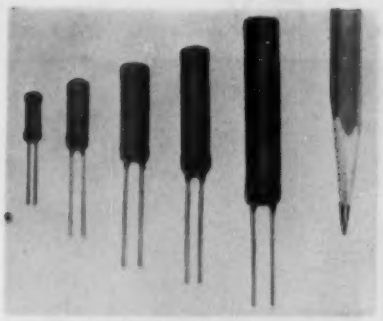

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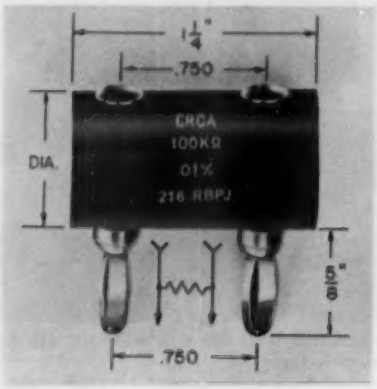

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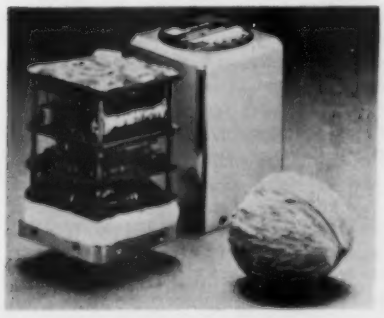

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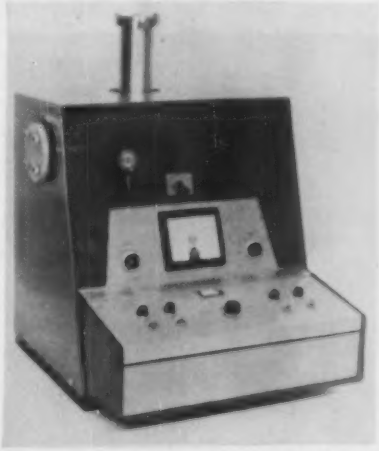

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Products for Aircraft and Missiles...

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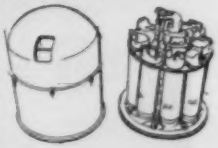

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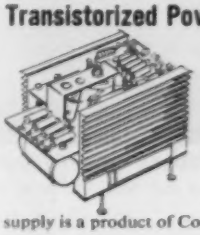

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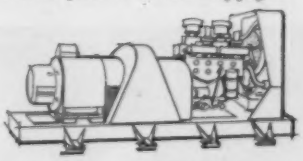

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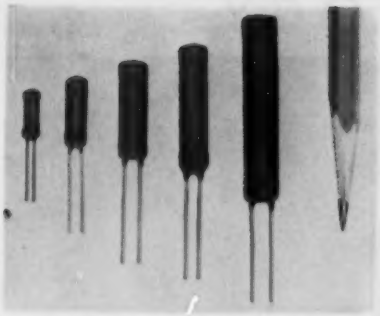

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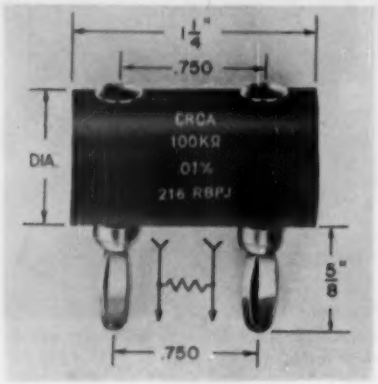

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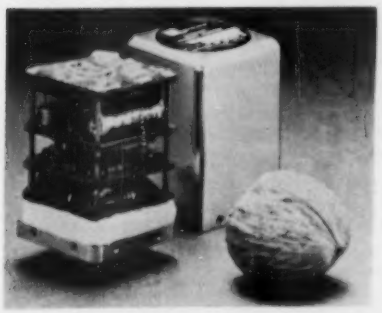

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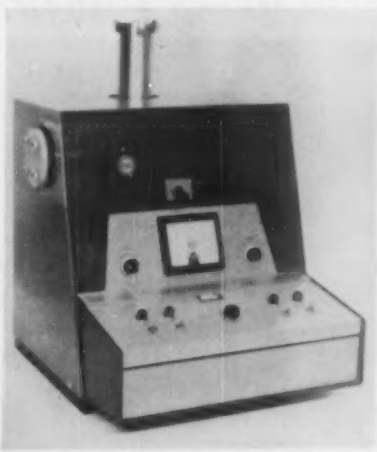

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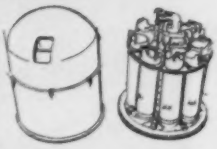

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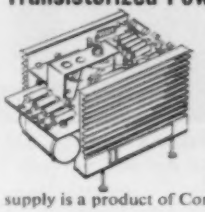

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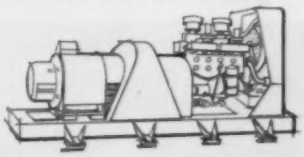

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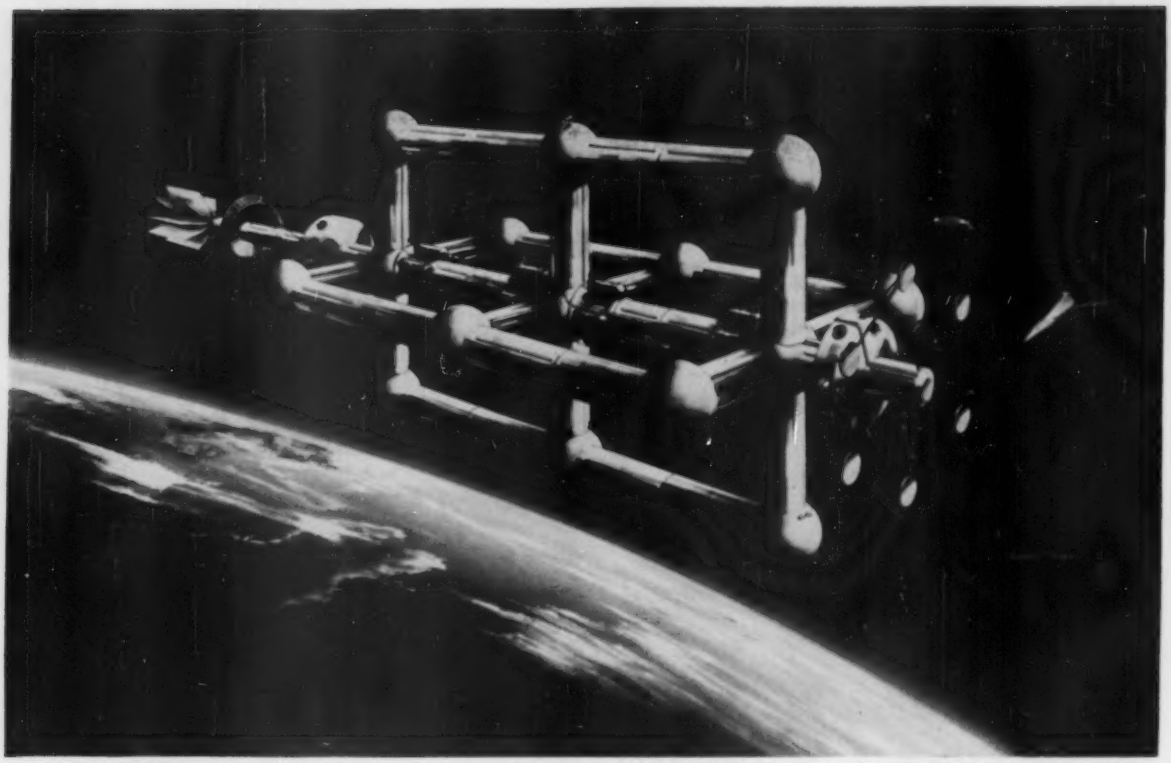
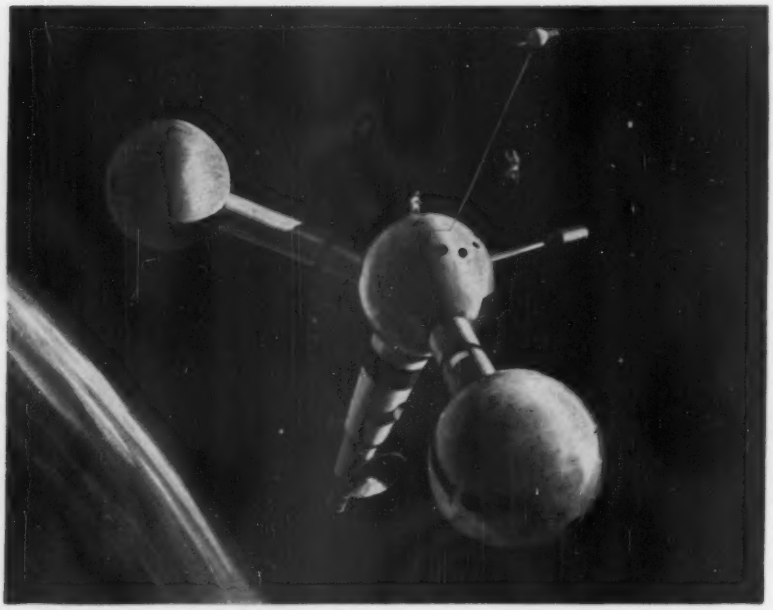


ADVANCED MODULAR design for multi-manned space station, proposed by Lockheed Missiles and Space Division scientists, will be assembled in space and orbit the earth at 318 mi. Station would consist of prefabricated units rocketed into orbit.

Space Pilots Show Superior Capabilities

By Richard Sweeney



GYROSCOPE EFFECT may cause manned space station to rotate continuously. Station could be expanded by adding modular units as desired to carry out experiments not possible on earth. Assembly would be made by a two-man "Astrotug" using mechanical arms.

Los Angeles—Pilots, using control systems and displays designed to make the most of their capabilities, not only will be an important part of forthcoming space systems but in a number of conditions will be far superior to automatic flight control systems in performance, according to reports presented at the Manned Space Stations Symposium here.

Systems analyses and simulator demonstrations which indicated the areas where the best results are obtained using a pilot supported the report.

One area, according to Eugene Levin of Rand Corp. and Jack W. Ward of Space Technology Laboratories, is in the docking phase of an orbital rendezvous. A device to provide a simulation of the essential features of the problem, utilizing an analog computer, was set up at Rand and a group of subjects worked space vehicle docking problems on it. Subjects included both pilots and nonpilots.

The displays provided over-all situation and orientation information on

an oscilloscope, while detailed quantitative information was supplied on a group of dials. The problem assumed clockwise rotation in coplanar orbits for an intercepting vehicle and a satellite.

The oscilloscope presentation used two dots, one representing the target satellite, the other the intercepting vehicle. From the intercepting vehicle, a light line indicated the velocity vector, the length being magnitude measure, while the direction is shown by the line's angle with respect to interceptor and target.

Thrust Controls

Two kinds of thrust controls were provided, on-off switches operating discrete levels of thrust in circumferential, retrocircumferential, upward radial or downward radial. The second control system was a conventional stick which applied variable levels of thrust in desired directions, with the amount of stick displacement controlling the quantity of thrust while direction of displacement controlled thrust direction.

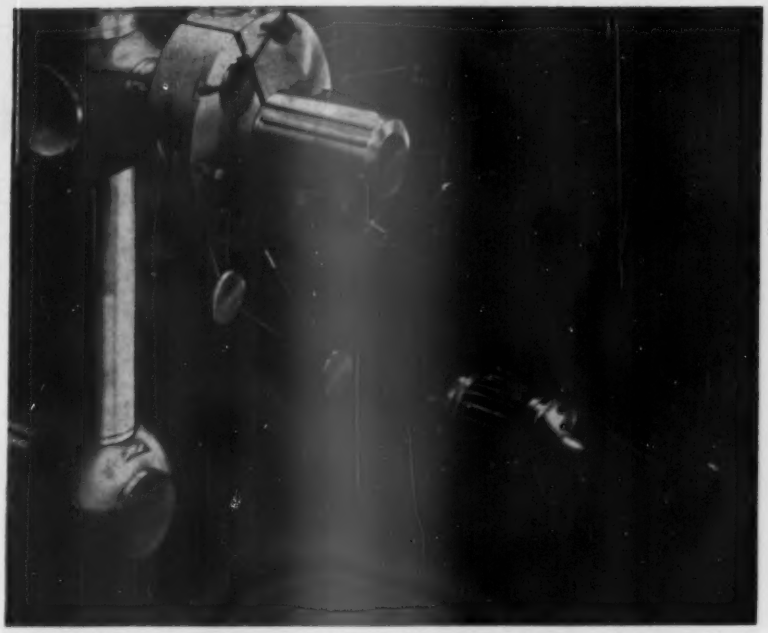
Findings were, according to the report, that the docking maneuver could be performed with great precision using unprocessed position and velocity data, achieving less than two feet of separation and about 1/100 fps. in velocity difference.

In cases where the docking phase was accomplished starting from a position less than a mile separation and relative velocity spreads of a few feet per second, it was found that a typical "good" docking was done in a small fraction of one orbit circle with an expenditure of 10-20 fps. in characteristic velocity.

Experiments were run in conditions of reduced information inputs, and trained pilots still were able to achieve docking with good efficiency. In another experiment, using trained pilots, the target station was represented on a plotter by a torus (doughnut), and pen traces indicated pilots could fly the intercept vehicle through the center.

Other phase of the intercept, the launch and distant closing, showed varied results in the pilot-vs.-automatic flight control system efficiencies.

In launch phase automatic flight control system had a clear advantage in efficiency, while in the distant closing phase there were conditions in which pilot efficiency approached that of the automatic flight control system in terms of fuel consumed.



FIRST UNITS of the modular space station are shown after being assembled by an "Astrotug." A 1g force will be created by slowly spinning the station along its longitudinal axis.

An automatic flight control system for a winged space vehicle which commands attitude changes during re-entry according to data supplied directly from a skin temperature rate-of-change feedback loop, was outlined by J. Stalony-Dobrzanski and O. Imai, of Hughes Aircraft Co.

Hughes' Design

Extending the innovations, the Hughes system design philosophy called for changing attitude in the roll axis as well as pitch, with the combination of temperature rate-of-change and roll-pitch attitude variations serving to minimize aerodynamic heating in re-entry and provide a wide margin of range control in the descent.

The Hughes approach uses two basic theories—that making the initial descent in a re-entry with the greatest obtainable lift will minimize aerodynamic heating, and effecting re-entry at velocities higher than the local circular velocity results in lower maximum temperatures.

The system operates to establish a vehicle pitch attitude prior to starting re-entry, which gives the highest available angle of attack during part of re-entry, the temperature rate of change increases, calling for a change of attitude which will give more lift.

However, the trim limits on the vehicle hold the angle to that already established.

Further along the trajectory, as the air gets denser, the combination of centrifugal force from velocity and aerodynamic lift becomes greater than weight and the vehicle starts to skip back up

Military Space Test Station

Los Angeles—A military space test station for scientific research and military tests will be the next logical step of the USAF in its evolution of aerospace vehicles, according to Col. Lowell B. Smith, chief of the Space Systems Office of Wright Air Development Division, ARDC.

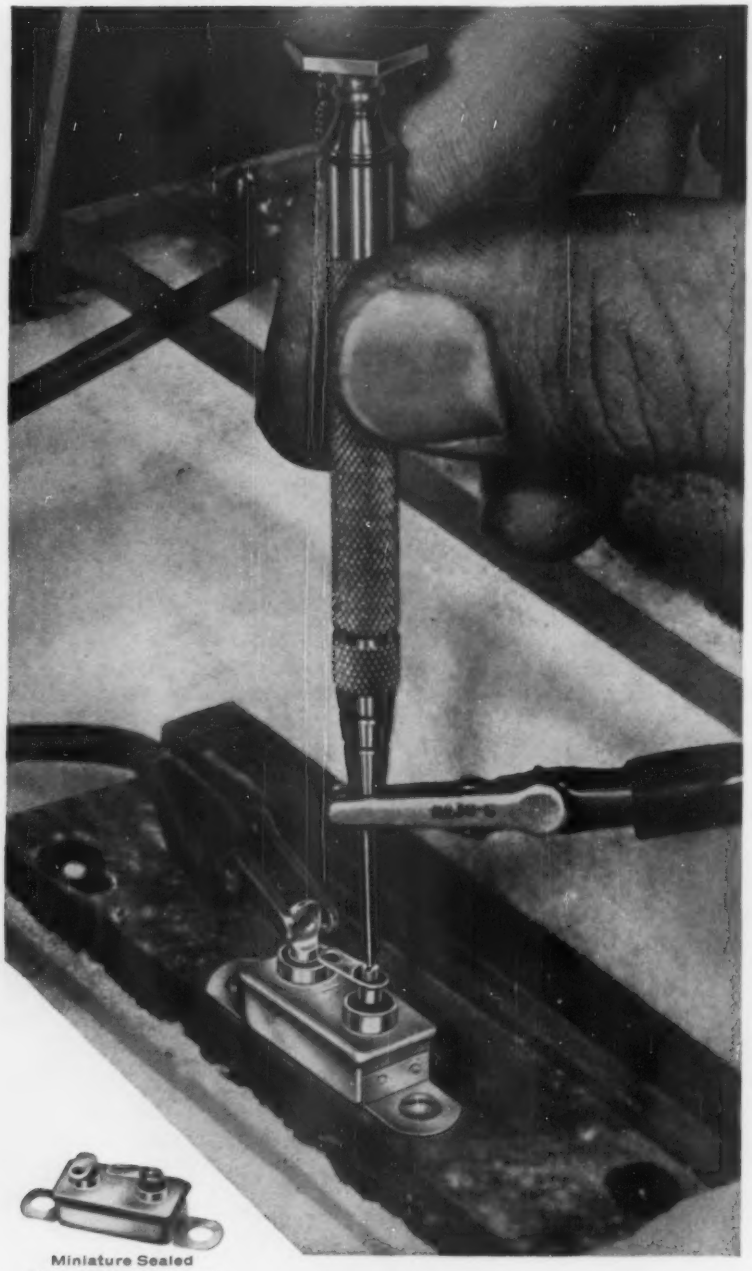
A search for a collection of fundamental scientific data would be equally balanced with the conduct of military tests and determination of the effects of space environment on people, mechanisms and weapons, Col. Smith indicated. Accumulation of knowledge about space as an environment for military operations is essential, he said, although areas of overlap between pure scientific research and military research and development exist.

With military and civilian activities participating as equal in a joint undertaking, the entire spectrum of basic sciences will be investigated, with attention particularly toward life sciences in the scientific research work.

In military testing, nuclear rockets can be tested without contaminating the atmosphere, engine starts in vacuum can be accomplished and guidance equipment for space-to-earth rockets can be tested and developed. The station can also serve for weapon system checkout, a training site for space crews and for the study of meteorology.

Development and operation of the station was seen as feasible in the early 1970 time period, with test areas including a life science laboratory, a celestial observatory area, a propulsion test area, vacuum test area and probe launching stations.

Tested To "Take It" on Missiles or Machines . . .



Miniature Sealed THERMOSWITCH Unit (actual size)

The Fenwal Miniature Sealed THERMOSWITCH® Unit

Here's the tiny temperature controller that's successfully handling some of today's toughest temperature control problems . . . in missiles and rockets as well as on production machines. Photo shows one of many quality control tests to insure product performance. *It's built to take a beating!*

Hermetically sealed, its rugged design permits normal control action even under the most severe conditions of shock and vibration. Stainless steel case is the heat-sensitive element . . . responds with instantaneous, positive action to heat changes of a fraction of a degree. Unit controls to extremely close limits. *Weighs less than ⅛ oz.!*

Easily set for *control* of temperatures from −20 to +200°F. When used as *high limit* switch, range is −20 to +275°F. Can withstand continuous exposure from −65 to +325°F. The Fenwal Miniature Sealed THERMOSWITCH Unit is widely used for crystal ovens, tuning forks, gyro assemblies, missile blankets, and missile batteries. Current rating: 2.5 amps, 115 VAC, 2.0 amps, 28 VDC. Find out how this advanced controller can protect the reliability of your product. Write Fenwal Incorporated, 126 Pleasant Street, Ashland, Mass.

Another example of how **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY

out of the atmosphere, still in its same initial pitch angle.

As the vehicle bottoms and starts its own pullup, the skin temperature rate of change reverses itself and starts downward. This commands a decrease in vertical force (lift), and this decrease prevents the vehicle from skipping out of the atmosphere again.

In effecting this decrease in lift, either the pitch angle can be varied or the lift vector changed by rotating the vehicle in the roll axis. Data from the skin temperature rate of change feedback loop can either move the elevators or the ailerons, or a combination of both, with the combination producing range flexibility.

Using the bank mode, maneuvering capability lateral to the plane of the orbit is achieved as well.

Analog Simulation

A complete analog simulation was run by Hughes using a vehicle with a weight approximating 17,800 lb. at re-entry and starting from a 300-naut.-mi. orbit which is left by a single retro de-orbiting technique.

The vehicle has 1,000 sq. ft. of wing area, uses two elevons of 111 sq. ft. each and two drag rudders with 15 sq. ft. of area each. One elevon and drag rudder are used on each side of the vehicle, which is shaped like an arrowhead, is 78 ft. 4 in. long and 44 ft. 2 in. wide, and has a mean aerodynamic chord of 29.8 ft.

Maximum design angle of attack used was 45 deg., which produced a lift-drag ratio of unity (one), and velocities varied from 26,092 fps. at an altitude of 60 naut. mi. where the atmospheric flight control system was considered to become operative, down to 4,000 fps. at 30 mi. altitude. Initial re-entry angle (at the 60 mi. point as well as the 300 naut. mi. point) of 1.5 deg. below the local horizontal was used.

Range Control

Using these parameters, and with a radiation heat disposal concept, the control system permitted range control from 4,700 naut. mi. from the start of re-entry to up to approximately 11,000 naut. mi. The system also kept the maximum heat inputs relatively low since the vehicle did not skip out of the atmosphere; instead, maximum lift angle of attack was kept and the lift vector varied by altering bank angle instead of pitch angle as heating rate of change increased.

The Hughes presentation also proposed a control system for space flight, which would be usable in the distant approach as well as docking phases of the orbiting vehicle intercept.

In both space and atmospheric control systems, manual pilot mode was included, and all simulations showed the pilot was fully capable of handling the vehicle throughout the entire performance envelope expected.

Proceeding from Project Mercury, future planning logically would include multi-man orbital vehicles, muti-man circumlunar flight, manned lunar exploration and manned interplanetary exploration.

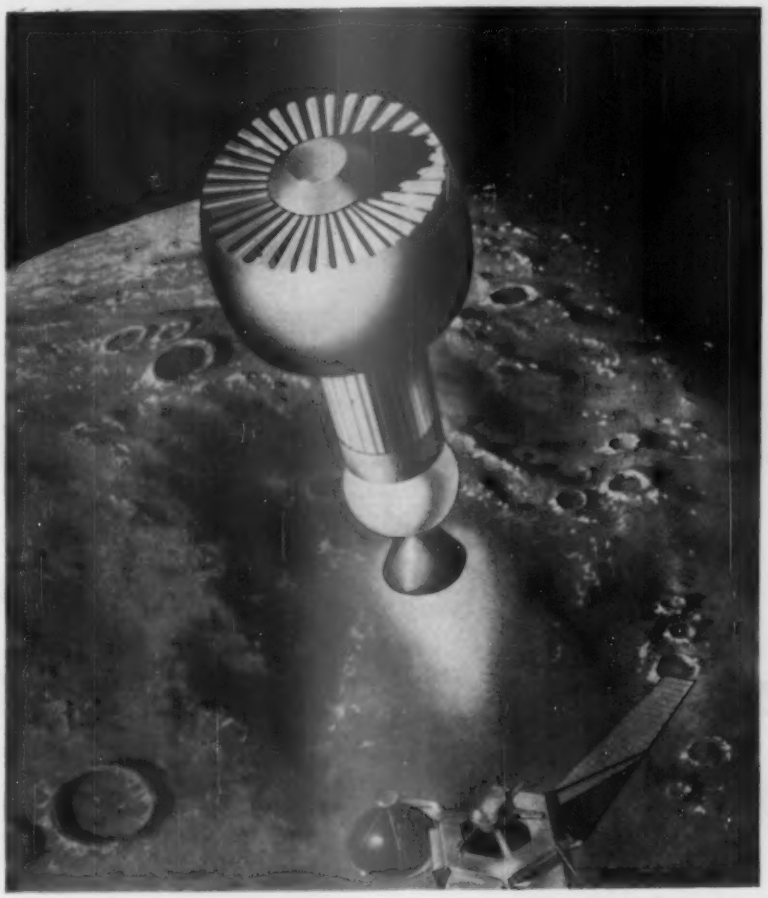
Probable Order

This probable order of achievement was outlined by Robert Gilruth and Kurt Strass of National Aeronautics and Space Administration's Space Task Force, in their presentation to the symposium.

Considering the factors involved, multi-man earth satellites should be achievable within the expected state of the art, and from these might logically be derived multi-man circumlunar vehicles although these would pose many difficult problems. The manned lunar landing and return should not be directly pursued at this time, according to the report.

While the degree to which space vehicles can be steered to chosen landing sites on earth after return from a mission is not yet clearly established, various possibilities are being studied. The quantity and quality of guidance, control and propulsion as required during the various phases of the flight which will be available will significantly affect the degree of landing site choice. Symmetrical capsule shapes with lift control flaps or lifting bodies appear most compatible with re-entry requirements dictated by escape speed, the report said, and rotors or steerable parachutes are possibilities for final descent.

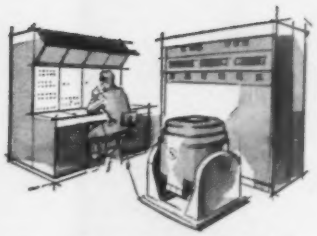
Onboard mission control is implicit in manned flight, the report stated, and "even in the Mercury system, substantial reduction in complexity of the



Aeronutronic Envisions Lunar Impact Vehicle

Project Ranger lunar-impact space vehicle envisioned by Aeronutronic Division of Ford Motor Co. has been proposed to NASA's Jet Propulsion Laboratory (AW Apr. 21, p. 26). Vehicle is designed to permit an instrumentation capsule to detach prior to the impact; it would be slowed by retrorockets. After launch, Ranger would orient itself on two axes, to collect solar energy and point its antenna to earth for radio guidance commands. As Ranger nears moon, it would take television pictures.

NEW line of MB hydraulic shaker systems to broaden scope of vibration/shock/fatigue testing



Pioneer and leader in the field of electrodynamic vibration systems, MB now adds a new dimension to environmental engineering with a complete line of hydraulic shaker systems. Operating in the low to intermediate frequencies, these systems—27 models in all—will provide vibratory forces from 1000 to 100,000 pounds, strokes as long as 9" D.A., and practical test load capacity from 5 to 15 tons.

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Compact, efficient, reliable—and above all, *conservatively rated*—these new shaker systems will perform as specified and promise to enlarge radically the scope of vibration, shock and fatigue testing.

Over four years in development and already service-proved, these new test systems are the result of MB's unparalleled experience in the field—plus its keen understanding of the needs of the environmental test engineer.

They are another reason why engineers everywhere recognize that . . . *the important advances in environmental testing come from MB.*

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capsule requirements could have been achieved had the usual straightforward, airplane-type approach been possible."

There is one manned space station design concept which has emerged from studies by several groups, the report noted, which appears attractive because of lead times and costs of obtaining flight hardware. This is the modular concept, which is illustrated by the use of one booster type to carry several types of payloads, as is planned for Saturn.

Under this concept, for a multi-man vehicle, one module would serve as the launch and re-entry vehicle as well as space flight mission control center. Should a long time in orbit or extended journey be planned, additional modules to meet the added requirements could

Orbital Solar Observatory

Los Angeles – National Aeronautics and Space Administration hopes to launch an orbiting solar observatory late this year which will be stabilized in space rather than in respect to the earth, Dr. Nancy G. Roman, head of NASA's Observational Astronomy Program, told the Manned Space Stations Symposium here.

The stabilization system will allow approximately 150 lb. of astronomical instrumentation to remain pointing at the sun with an accuracy of one minute of arc. The instrumentation will be designed to obtain detailed spectra of the sun in the soft X-ray and far ultraviolet wavelengths and measure and monitor the X-ray emission from the sun.

In about three years, Dr. Roman said, a larger satellite will contain more advanced instrumentation for similar purposes, and possibly instrumentation for obtaining images of the sun in the far ultraviolet, for studying solar corona in wavelengths not visible from the earth's surface, and for studying the sun in wavelengths not previously observed.

This satellite also will be instrumented to study the earth, its upper atmosphere and nearby space regions, with particular attention to be paid those phenomena believed to depend on solar radiation.

Another project scheduled for flight in about three years, Dr. Roman said, is an orbiting astronomical telescope which will be part of an orbiting astronomical observatory. Stabilization of this satellite will permit the telescope to stay pointed at a particular star within a fraction of a second of arc for periods of up to an hour, and provisions will be included for redirecting the scope from one star to another by control from the ground. This project was first announced last year (AW June 15, 1959, p. 32).

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This new ground support air conditioning package by Stratos provides a cooling capacity of 38,000 BTU/hour when equipped with an 8-hp 7,550 rpm motor compressor unit . . . and 50,000 BTU/hour with a 13 hp 11,500 rpm unit. Weighing only 350 pounds complete, measuring just 40" x 24" x 49", and rated at 3.2 or 4.2 tons, the Model VEA4-3 air conditioner amply demonstrates the high capacity that can be achieved in a compact package – due to Stratos' unique Heli-Rotor compressor and efficient evaporators and condensers. The rugged VEA4-3 unit meets military specifications.

Specifications:

Conditioned air flow	80-90 lb/min.
Output Temperature	Automatically controlled 60° to 90° F ±2°
Weight	350 pounds complete with cabinets, charge and controls
Heating Capacity	37,000 BTU/hr. (11 kw)
Electrical System	208 or 416 V 3 phase, 400 cycle, 4 wire
Cooling Capacity (with condenser air temperature at 125° F)	38,000 or 50,000 BTU/hr.
Controls	Remote panel, cable connected
Refrigerant	Refrigerant 12

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TIROS WEATHER SATELLITE IN ORBIT

Allied Research System Key To Interpretation

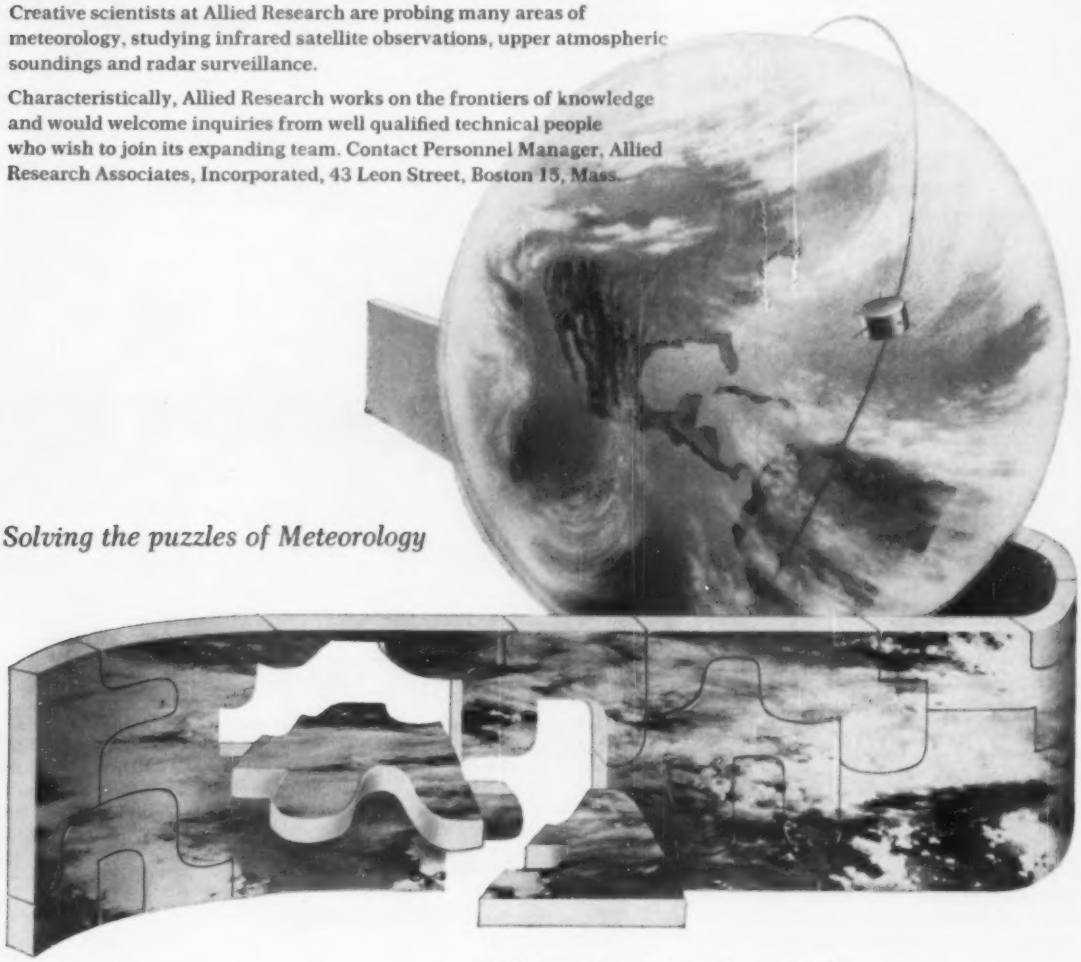
With the launching of TIROS, the United States makes a significant contribution to world meteorology. Satellite telemetered pictures are being studied for potentially useful weather forecasting information by scientists from key governmental activities and Allied Research.

Allied Research assisted in training personnel at the data gathering stations which transform satellite data with photogrammetric grids to cope with problems produced by the spin and orbital motion of the satellite and by the curvature and rotation of the earth. In this procedure scientists employ methods developed by Allied Research.

Meteorological interpretation and techniques for transmission of TIROS data are other areas in which Allied Research contributes.

Creative scientists at Allied Research are probing many areas of meteorology, studying infrared satellite observations, upper atmospheric soundings and radar surveillance.

Characteristically, Allied Research works on the frontiers of knowledge and would welcome inquiries from well qualified technical people who wish to join its expanding team. Contact Personnel Manager, Allied Research Associates, Incorporated, 43 Leon Street, Boston 15, Mass.



Solving the puzzles of Meteorology

Allied Research work done under contract to Geophysics Research Directorate of the Air Force Cambridge Research Center. TIROS project sponsored by NASA.

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A BOEING SUBSIDIARY

be attached like cabooses on a train. The caboose could be entered in flight by the crew, but would not have to re-enter or have crew escape provisions, and also could hold additional equipment pertinent to the given mission.

Several concepts of orbital manned station designs were presented at the meeting, with various approaches to structure, fabrication, assembly location, ranging from a single unit as proposed in a report by Martin Co. engineers (AW Apr. 25, p. 37), to a modular assembly envisioned by Lockheed Missiles and Space Division's Saunders B. Kramer and Richard A. Byers.

Significant Variables

In a discussion of factors influencing selection of a manned space station concept, Joseph H. Doss and Leo J. Montague of Boeing Airplane Co. chose mission, time and money as the most significant variables.

A basic choice, they indicated, was whether to preassemble the entire station on earth or to assemble modules in orbit. In view of present U. S. booster development plans, their conclusion supported the NASA idea of modular assembly in space, with the modules preassembled on earth and made as large as booster capability permits.

With a 1.5 million lb. thrust booster and high energy upper stages, a payload weight (module) of 40,000 lb. could be placed in a 300-mi. orbit. A very important aspect of the booster which affects the cost-weight ratio was providing for recovery and re-use of these boosters.

Self-Contained

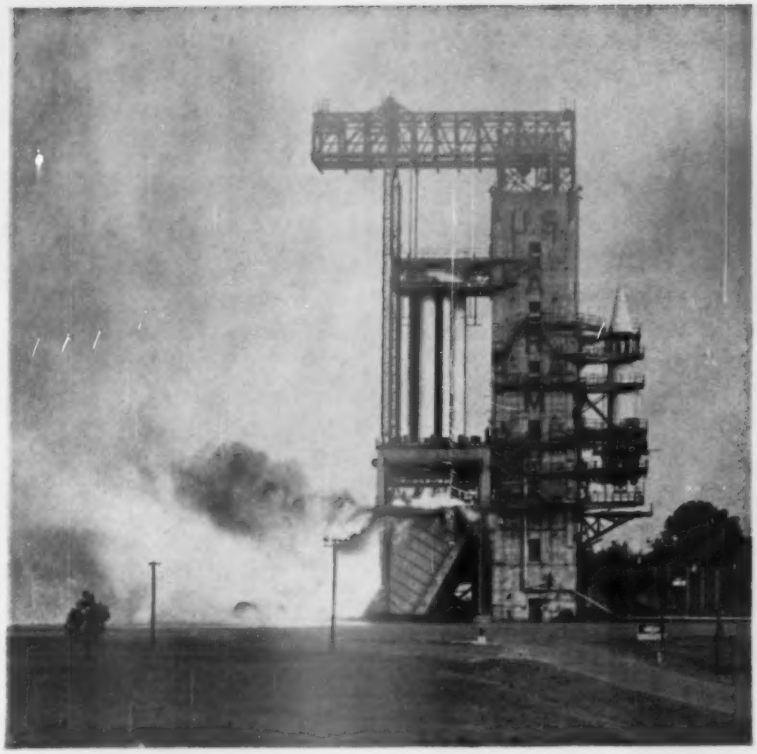
The concept of Kramer and Byers, based on "a conservative extrapolation of the science of astronautics over the next 10 years," had each module as a self-contained vehicle. This way, crew survival problems are reduced, they said, and also assembly complexity, while provisions for evolutionary growth were included at minimum technical obsolescence cost.

Two module shapes were proposed, 10-ft.-dia. cylinders 30 ft. long, and 18-ft.-dia. spheres. The first station would consist of two cylinders with a sphere at each end.

Station orbit altitude is below the Van Allen radiation belt, yet as high as possible to reduce atmospheric drag. Provisions for offsetting orbit decay are included.

An artificial 1g gravity force is provided by rotating the station about its central axis.

Along with the modular space station concept, the presentation proposed two vehicles—an "astrocommuter" and "astrotug." The commuter is the rendezvous and re-entry vehicle for crew change and resupply and additional to-from tasks, while the tug is a utility mover which stays with the station in orbit.



First Static Firing of Eight Saturn Engines

Successful first static firing of all eight engines of Saturn space vehicle booster (AW May 9, p. 19), conducted at Huntsville, Ala., lasted eight seconds and developed about 1,300,000 lb. thrust. Full duration firing of engines, which will last 120 sec. if all function properly, is planned for June. Photo was taken from blockhouse, 1,000 ft. from test tower.

Structural proposals and approaches outlined at the sessions included inflatable-in-orbit techniques as well as standard assemblies, plus presentations on effects of radiation on structures, meteoroid impact and implications, the role of damping in space structures and using the structure to provide a significant degree of thermal control for the vehicle.

Double Shell

Using a double shell with the proper material between to provide required additional strength at high and low temperature extremes was proposed by Peter E. Glaser of Arthur D. Little, Inc.

An automatic control system would regulate gas flow into individual panels of the vehicle structure according to thermal requirements for the cabin and occupants while in orbit. The gas used in orbit would possibly be different from that used in ascent and re-entry, since the combination of gas, insulation material and temperatures encountered in these cases would have to meet different strength and thermal protection requirements than the orbital condition.

Dust-Fueled Reactor

A circulating dust-fueled, radiation-cooled reactor to provide electrical power in orbit was outlined by W. R. Corliss of the Martin Co. Prime advantages, Corliss said, are use of static equipment and rejection of liquids and gases as working fluids and heat transfer agents.

Uranium carbide or plutonium carbide dust would travel in a racetrack path, with the flow controlled electrostatically. A neutron reflector to generate fission would be incorporated on one section of the track, while just beyond it there would be a section of thermionic power generators to convert part of the heat to power, while the remainder of the heat is radiated back to space.

Production of large quantities of power is inherent in the concept, to offset the system weight, according to the report, which also acknowledged that certain areas of the concept need considerable research and development effort.

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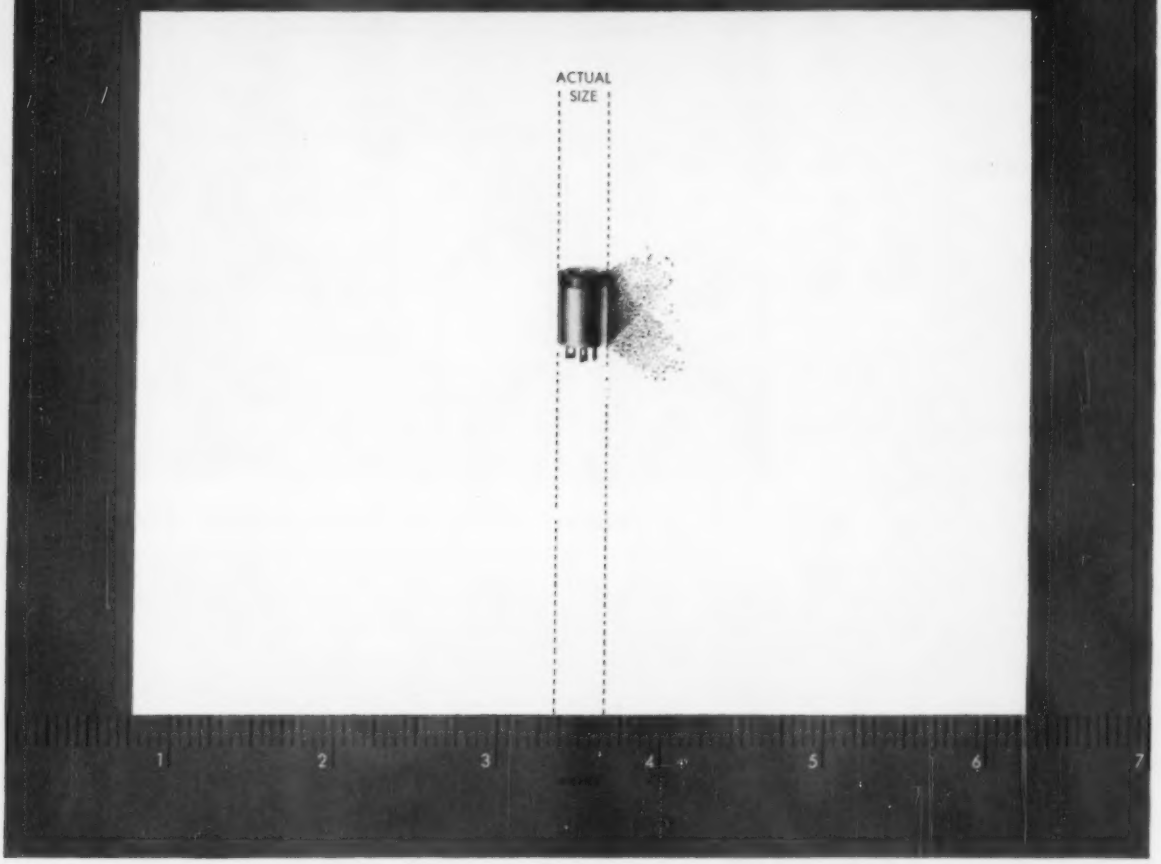

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Actuating force	12 ± 8 ozs.
Release force	1 oz. minum.
Pretravel	.005" approx.
Overtravel	.003" min.
Movement differential	.002" approx.
Minimum life cycles	10,000
Weight	.036 ozs.
Amb. temp. range	65°F to 275°F
Current capacity	3 amps. 28VDC resistive
Contact separation	.010" approx.
Vibration resistance	40 G's
Shock resistance	100 G's

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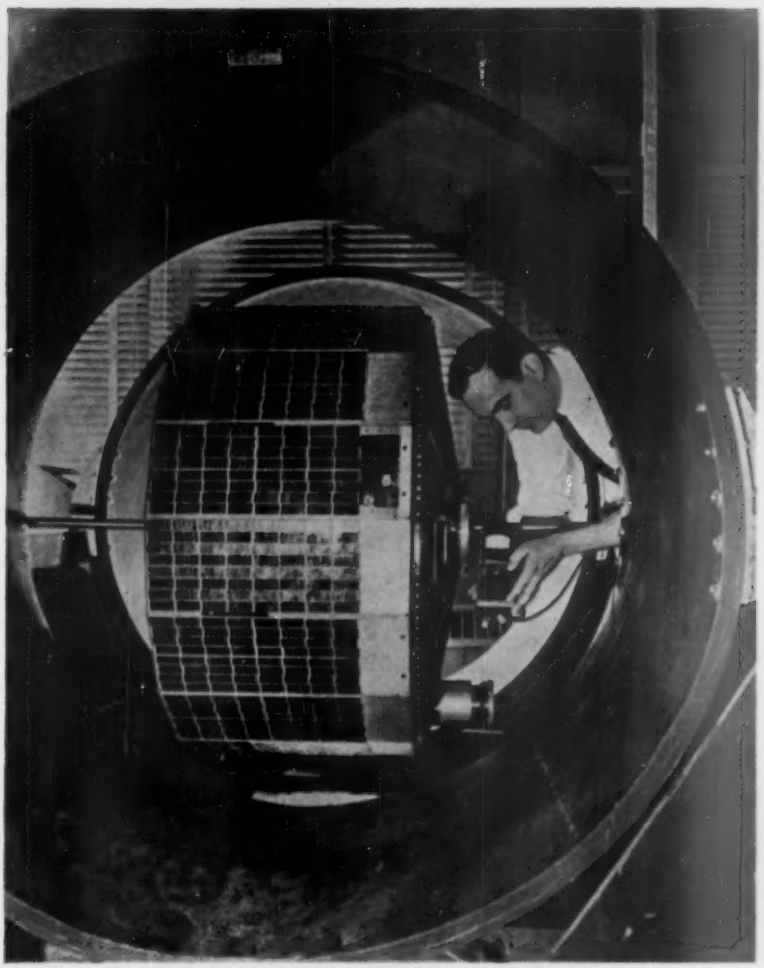


EFFECT of earth's magnetic field on Tiros satellite is measured by RCA Astro-Electronic Products Division technician, using this specially-designed magnetic drag test device.

Tiros Satellite Orbital Heating Problems Keyed Design Parameter

By William S. Reed

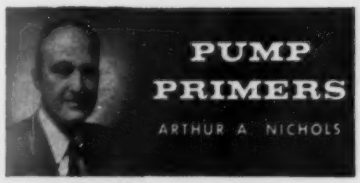
Santa Barbara, Calif.—Design of the Tiros meteorological satellite (AW Mar. 14, p. 26) was described by R. W. Northrup of Radio Corp. of America at the American Rocket Society Conference here.

The satellite is the product of planning and experimentation which began in 1957 under contract to the Army Ballistic Missile Agency and the Advanced Research Projects Agency.

Even though it was determined that each constituent of the payload would satisfy operational requirements in a range of temperatures, it became necessary to limit temperature excursions as much as possible by design of the exterior and interior surfaces and joints. Basically the heat sources within the satellite dump directly to the base plate, and since the entire device is spin-stabilized in inertial space, selection of the geometry and radiative-absorptive coatings was directed at dumping heat from the mass accumulator.

Considerable effort was expended to achieve coating of the solar cells so as to mask out that spectrum band of the sun above the visible which merely heated up the top section and payload without contributing to power. To distribute solar heat input internally, the main mass, baseplate, and side plates were painted black. Once the selections were made, an orbital temperature variation history was analytically generated.

Structural design synthesis of a non-



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Recognized as an extremely attractive theoretical design 30 years ago, there were many abortive attempts to produce Gerotor pumps.

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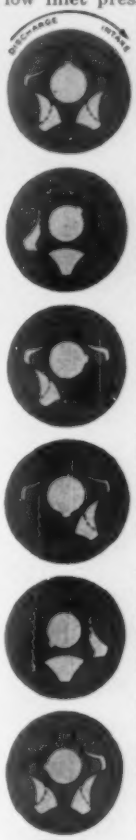

FIG. 1

▸ **Operating cycle – The Gerotor pump is a form of internal gear pump in which the inner element always has one less "tooth" than the outer. Both turn in the same direction. The volume of the missing tooth multiplied by the number of driver teeth is the volume of fluid pumped per revolution. Either the inner or outer Gerotor can be driven (Fig. 1).**

The Gerotors are mounted on fixed centers eccentric to each other. As they turn, the chamber between the teeth of the inner and outer Gerotor gradually increases in size through the initial 180° of revolution until it reaches the full volume of the missing tooth.

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In the second 180° the teeth mesh, decreasing the size of the chamber as it passes the discharge port, forcing the liquid out.

▸ ***Technical Data – is available and your inquiry is invited. Write:***

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recoverable, manned, 14-day scientific laboratory was presented by J. W. Bilodeau and D. M. White of Chance Vought Aircraft, Inc. They contended that the design and fabrication of such a vehicle is feasible today.

Three-Man Crew

The three-man crew for a 14-day orbit was selected as a choice between the extremes (two men for five days, or five men for 30 days) which appears to encompass the range of possibilities for second generation manned space systems.

Simplicity was emphasized to realize the objectives of high reliability and reasonable structural weight. In addition, a simple design would do much to reduce the vehicle cost. Light weight is considered of prime importance because it permits larger internal loads and more growth potential.

The laboratory would be a cylinder 81 in. in diameter and 16 ft. in length. It could be one of several modules which could be re-supplied and connected in space. Total weight would be approximately 5,000 lb. For a 30-day, rather than a 14-day mission, the diameter would increase to 105 in. and over-all weight to more than 10,000 lb., due mainly to the increased weight of the electrical power supply and communications equipment.

In another talk, Kenneth E. Hogeland, of Convair Astronautics, said a winged recoverable booster will ensure the largest degree of reusability since the return to base eliminates the necessity for a recovery rendezvous. Design is for surface impact loads and the problems attendant with salt water immersion.

Winged Booster

Since wings represent a considerable addition of weight, additional thrust must be provided to maintain performance, which in turn requires additional propellant and propellant tankage. The result of providing recoverability is that a first stage winged booster would necessarily be about 60% greater in size and weight than an expendable first stage booster.

However, Hogeland argues that the winged booster will be more economical for high launch rates.

Booster mission, as seen by Hogeland, is establishment of a payload in a 100 naut. mi. hovering orbit. The first stage burnout point is between 250,000 and 400,000 ft. at a velocity of 8,000 to 14,000 fps.

The entire vehicle, including payload and booster, flies from a vertical take-off along a zero lift or ballistic trajectory to first stage separation. At launch, critical thrust loads are caused by booster engine thrust buildup producing transient loads in the propellants when

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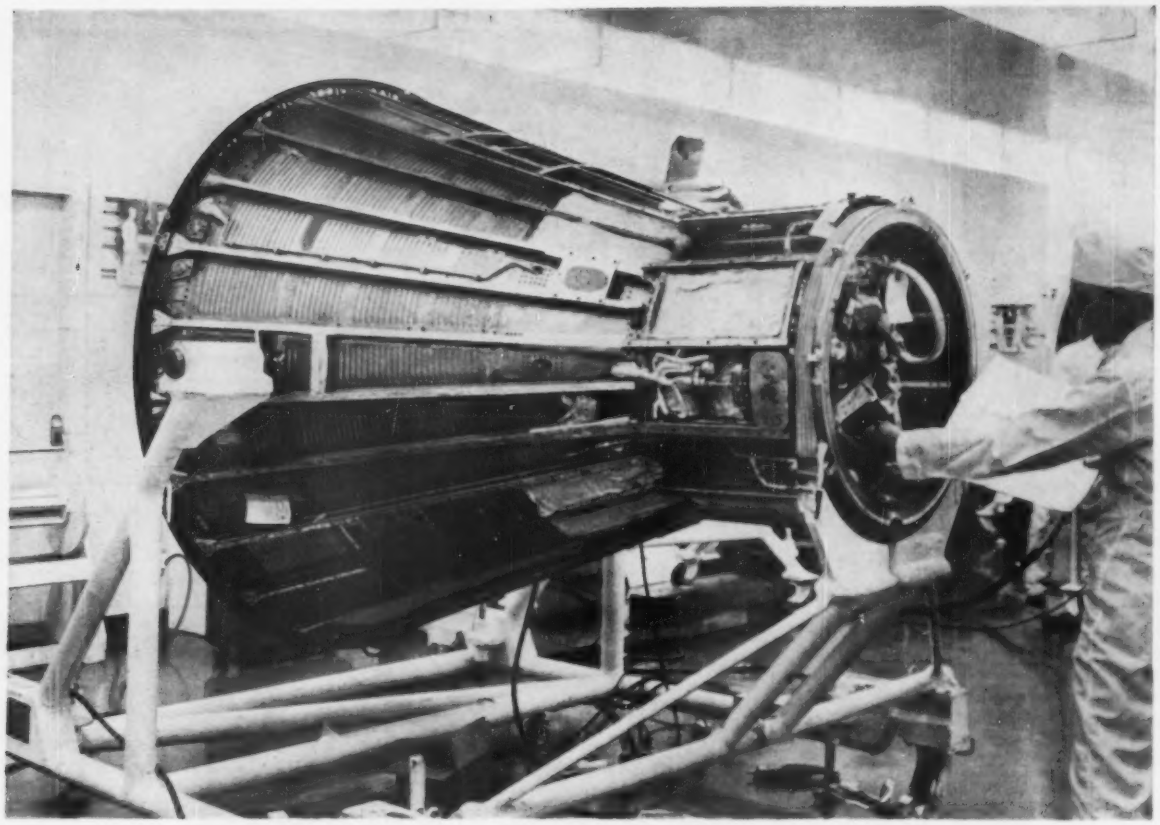

Internal Systems Installed in Mercury Capsule

Subsystems for Project Mercury man-in-space capsule are installed in this superclean room at McDonnell Aircraft Corp. (AW May 2, p. 29); note nylon uniform worn by technician to cut dust collection possibility. Outer shingled capsule skin has not yet been installed.

they are at maximum volume.

Critical in-flight loads result during the launch phase and usually occur at the time of maximum dynamic pressure. At this time the maximum of the combined bending moment, actual acceleration and drag loads, and shear loads occur on the fuselage.

After separation of the upper stage and payload from the winged first stage, the winged booster is unpowered and continues on a ballistic flight path to apogee.

The loads that occur during this period are low due to the absence of atmosphere and have no critical designing effect upon the airframe.

Critical Phase

From apogee, the most critical phase of flight begins—re-entry. The initial period of re-entry for the winged booster also is ballistic, since in this flight regime weight is greater than lift, plus centrifugal force.

As atmospheric density increases, so do airframe temperatures and loads. Due to the high angle of attack attitude of the winged booster and its hypervelocity, the lifting forces are maximum for the whole mission.

In addition, the magnitude of the re-entry normal forces combined with lift due to positive pressure on the lower surface, and drag, exceed any other load combination in other flight regimes and therefore become the designing conditions.

The remaining portion of the mission profile, the cruise to base and landing, does not present any unique loading conditions except perhaps taxi loads on the ground.

Design Problems

The problems confronting airframe design of a winged booster are difficult compared with a conventional aircraft because of its size in relation to its loading conditions and the environment in which it must operate. By similar comparison, the missile or expendable booster is short-lived, while a winged booster airframe must be designed for a long service life. Therefore, a winged booster must exhibit the endurance properties of an airplane while operating in the extremes of a missile environment.

Hogeland suggested that wing components subjected to extremely high temperatures, such as leading edges, will be designed for a limited useful life and be replaceable.

Mice Deliver Young In 2g Environment

Litters of mice have been conceived, delivered and reared in a centrifuge under twice the pull of earth's gravity, and other mice have grown in a centrifuge for a year at 7g, State University of Iowa researchers have reported.

Dr. Charles Wunder, assistant professor of physiology, and graduate assistant Stanley Briney reported that the mice do not eat as much food as usual when they first go into the centrifuge and that they decrease in size. After a few days they begin to eat more and gain back some of the lost mass. Within two weeks, they are larger than before the start of the experiment. They continue to grow but never attain the size of normal or controlled animals. Bones appear to grow faster than other parts of the animals.

Primary purpose of the six and one-half-year program, supported in part by the Public Health Service and the American Cancer Society, is to study factors that control growth.

Wunder believes the findings will be important to manned space flight researchers.

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At 00ʰ00ᵐ01ˢ GMT, May 1, 1960,
Martin logged its 523,692,000th mile
of space flight

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This mammoth excavation, somewhere in the United States, will soon be a "hard base"—an almost invulnerable underground launch site for the Air Force TITAN Intercontinental Ballistic Missile.

It is an important element in the United States Air Force Strategic Air Command's mission—to prevent war.

The job of this TITAN hard base—and the others like it—is to insure that we will have such devastating retaliatory power, even under concentrated nuclear attack, that no enemy will consider war.

Bases such as this cannot be built overnight. It is a credit to the foresight of our military planners that the bases will be operational concurrent with the TITAN ICBMs now in production at Martin-Denver and undergoing advanced tests at Cape Canaveral.

MARTIN

new system for flight safety

Uses Hughes TONOTRON tube to combine radar screen with pilot's field of view

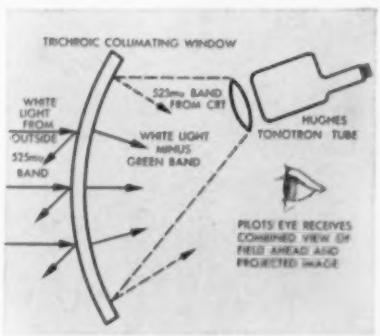
Aptly called the "Magic Window," this new pilot display system developed by Autonetics Division of North American Aviation, presents any luminous pattern produced by a Hughes TONOTRON* tube as an image painted in front of the pilot's normal view. Day or night, in any weather, the pilot can avoid obstacles, maintain attitude, safely accomplish difficult landings.

The grid shown is just one typical application. Any radar mode—terrain, fire control, weather, etc.—can be projected on the "Magic Window." In the ground mapping mode, the TONOTRON tube provides high fidelity reproduction of any desired information with high picture brightness and controllable persistence.

Hughes TONOTRON tubes are ideal for a wide range of applications including: Sector Scanning, "B" Scan Radar, Weather Radar Readout, Armament Control Radar, Plan Position Indicator information and Slow Scan TV.

TONOTRON tube models are available for your use in sizes of 3, 4, 5, 7, 10 and 21 inches—with electrostatic or electromagnetic deflection.

For detailed information and application data on TONOTRON tubes, write or wire: HUGHES, Vacuum Tube Products Division, 2020 Short Street, Oceanside, Calif. For export information, write: Hughes International, Culver City, Calif.


TRICHROIC COLLIMATING WINDOW
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WHITE LIGHT FROM OUTSIDE
525mμ BAND
WHITE LIGHT MINUS GREEN BAND
HUGHES TONOTRON TUBE
PILOTS EYE RECEIVES COMBINED VIEW OF FIELD AHEAD AND PROJECTED IMAGE

A narrow band of light in the green spectrum is prevented from coming through the "Magic Window." The TONOTRON tube projects a green pattern back onto the screen to form the image.

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HUGHES AIRCRAFT COMPANY

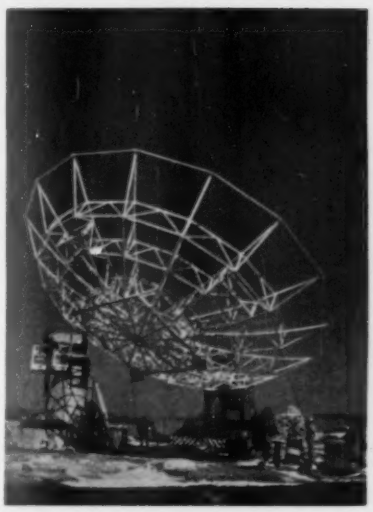
VACUUM TUBE PRODUCTS DIVISION

*TRADEMARK OF HUGHES AIRCRAFT COMPANY

Deep space tracking complex is located near Alpha Corp.'s Dallas plant; vans in foreground correlate tracking data.

Facility Performs Deep-Space Tracking

Deep-space tracking facility built by Alpha Corp., subsidiary of Collins Radio Co., near Dallas, Tex., is a dual-purpose site which can be used for checkout of equipments prior to shipment for installation at customer-selected locations. Site also can be used as a permanent tracking station. The 40-ft.-diameter antenna (right) on the test site is the first of three being built by Alpha as part of the $6.25 million contract awarded by U. S. Army Signal Corps for several of these stations to be delivered this year; program is a joint Signal Corps–Advanced Research Projects Agency project. The antenna now installed probably will be permanently located at the Dallas site; indications are that among its future uses will be a tracking role in the Mercury manned space vehicle program. The other two antennas and transportable tracking stations are expected to be based in foreign countries. Aerial view (above) shows the deep space tracking complex. In the foreground are four trailer vans which (left to right) house receiving, servo, data and telemetry equipment for the deep space tracking antenna. Not shown is a fifth van which would house communications equipment for transmitting data from tracking stations to a central computing facility. Alpha's contract role is one of design and system management, including architectural and construction phases. Company also trains user personnel.

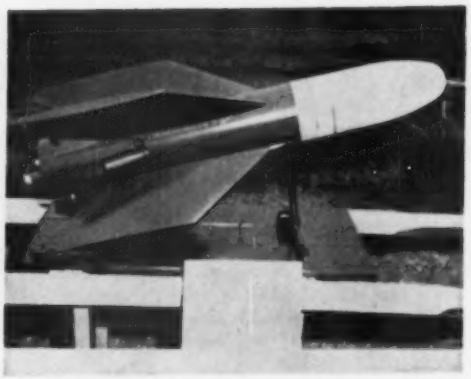


Servo van (left) contains facilities for testing and repairs. At right, test director monitors receiver and servo consoles.

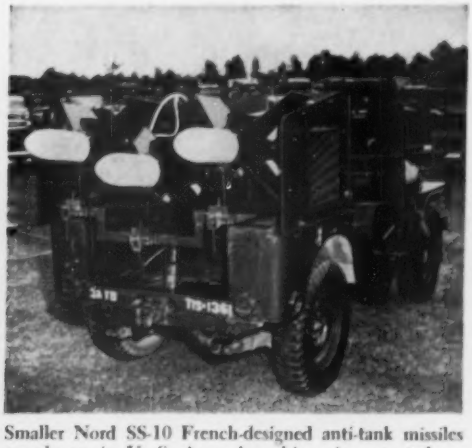
First photographs of AN/USD-5 show Fairchild surveillance drone on zero-length launcher. Delta-winged drone will use Pratt & Whitney's

Army Stresses Mobility, Firepower in Weapon

Army weapon display at Fort Benning shows Nike Hercules in the foreground, with mockup of new Nike Zeus behind it, followed by Hawk cluster, Honest John, Lacrosse and Corporal.



Nord Aviation's SS-11 anti-tank missile can be fired from light helicopters.



Smaller Nord SS-10 French-designed anti-tank missiles are shown in U. S. Army launching rig mounted on back of ¼-ton vehicle.

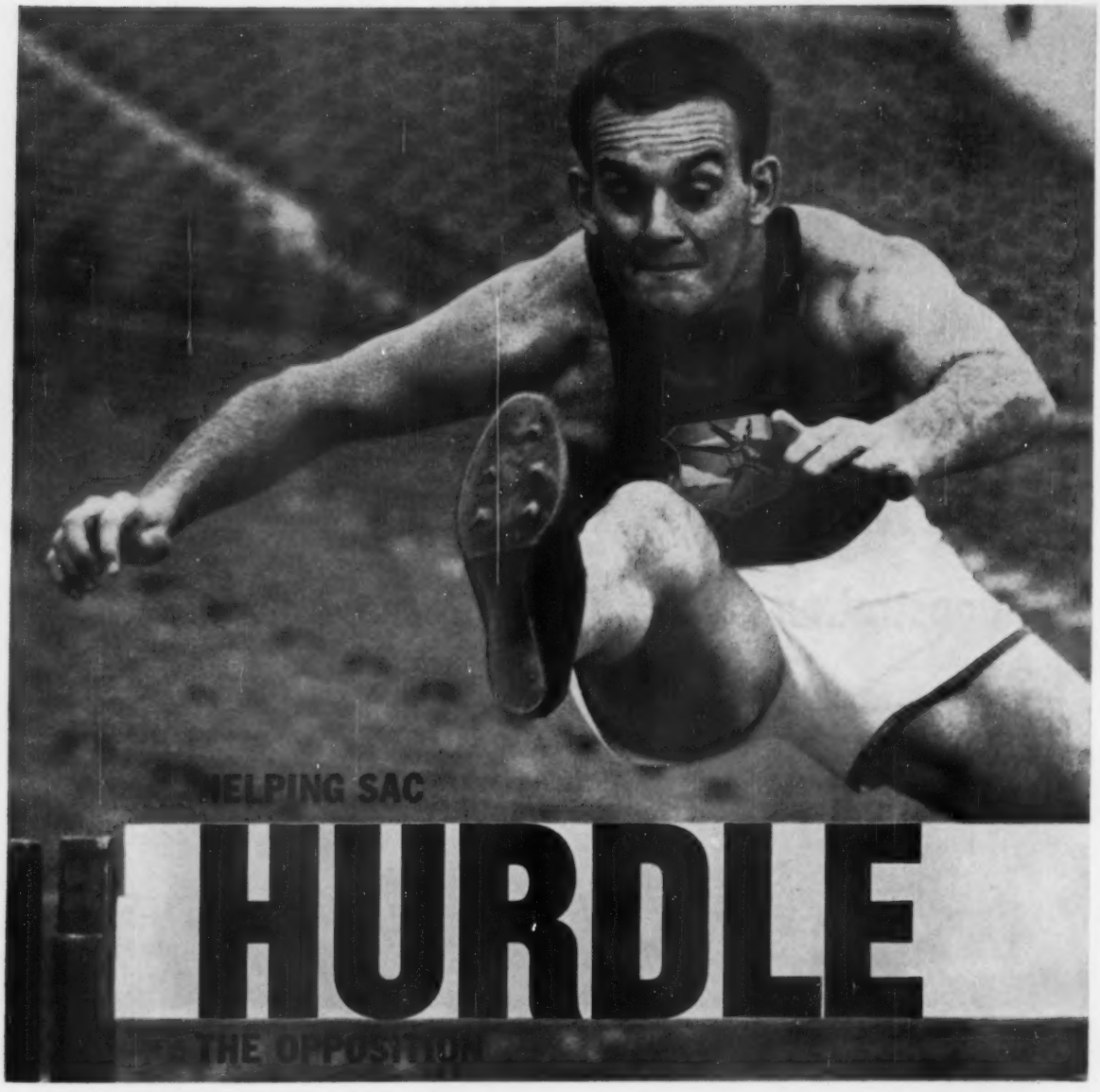
MISSILE ENGINEERING

436-lb. J60 (JT-12) turbojet engine. Martin's Lacrosse command-guided missile, mounted on launcher, is a corps weapon for close support.

Demonstration

Extreme mobility, massive firepower and improved surveillance and communications were the characteristics stressed by the Army in its parade of new weapons during recent project MAN demonstration at Ft. Benning, Ga. (AW May 9, p. 85).

The new weapons, some of which are still in the development stage, were shown in static displays and demonstrated in live firing. Most of the weapons are designed to be moved easily and rapidly by helicopter, truck or man. At right, President Eisenhower watches Pershing missile on new transporter-erector-launcher. Army's new Davy Crockett weapon system (below), will have nuclear capability.



SAC is now off and running with its new Hound Dog missile. With the supersonic GAM-77 missile, the B-52 bomber can more easily hurdle ground defenses on the way to a target. In the short span of just 30 months, the Hound Dog air-to-surface missile grew from the drawing board to a powerful member of SAC's deterrent team.

Silencing enemy ground defense centers while the mother ship speeds on toward the main target is just one of the jobs of the versatile GAM-77 missile. Slung beneath the swept-back wings of a B-52, a pair of GAM-77's can either clear a path for the bomber, or be sent right in on the main target itself. This triple-threat capability lets a single B-52 command a target approach corridor over a thousand miles wide.

To further confuse the enemy, these inertially-guided missiles can feint at pseudo-targets before turning toward their real objectives. Speed and altitude variations can also be programmed into the GAM-77's target approach.

The Hound Dog missile greatly extends the useful life and striking power of SAC's B-52 bombers—the backbone of America's strategic power. The GAM-77 is being produced by the Missile Division of North American Aviation.

MISSILE DIVISION
NORTH AMERICAN AVIATION, INC.
Downey, California

Navy Project Hydra Demonstrates Water Surface Launch Possibility

Pt. Mugu, Calif.—Principle of Project Hydra, Navy proposal to launch large solid propellant rocket space vehicles from the surface of the sea, has been demonstrated here with a 6 ft., 150-lb. wooden vehicle powered by a 2.25-in. Aeroscar rocket.

Chief significance of the launch is the Navy decision to promote interest in the project, in the opinion of military and civilian observers at the demonstration. The concept of Hydra is reported to be arousing strong interest among space program officials.

Navy shortly will launch a longer shape powered by a cluster of Sparrow solid propellant rockets. Hydra is being conducted by Lt. Cdr. J. E. Draim and Lt. C. E. Stalzer, of Pacific Missile Range Astronautics Department.

Navy is quietly emphasizing the maritime problems of handling large vehicles at sea but the Hydra proposal is almost certain to conflict with the Defense Department order assigning big booster development to USAF. The ability to launch from virtually any latitude without a large investment in pads and other installations is one of the key advantages claimed for Hydra and ties in well with the Pacific Missile Range practice of using shipboard and mobile installations to avoid diplomatic haggling, conflict with civilian interests and duplication of facilities.

The Germans successfully launched liquid propellant missiles floating in the sea in World War II. The Russians are reported to be working on an advanced form of the German scheme. Navy contribution is the adoption of solid propellants and the proposal that the concept be used to launch space vehicles of virtually unlimited size.

Navy says Hydra can be used between 1960 and 1975 when nuclear propulsion should be ready. Navy officials feel that the Hydra sea launching technique will still be useful with nuclear rockets. For the more immediate future, they say existing vehicles such as NASA's Scout could be adapted for Hydra-type launching at a low cost.

They point out that the ratio of solid propellant rocket specific gravity to that of sea water ranges from 1.0 to 1.40. This would indicate that a buoyant jacket on upper stages would be adequate modification for a rocket-like Scout. Jacket would be jettisoned after launch. Another solution would be a small flotation ring left on the surface of the sea. For a new vehicle, basic design might incorporate somewhat more buoyancy than that of present motors. This could be done by increasing the size of the hollow charge port in the center of the grain.

Solid propellant rocket nozzles intended for air ignition are customarily sealed by a diaphragm to cause a stronger pressure pulse when the igniter fires and to cut down deterioration of the propellant surface. The seals are

Hound Dog Undergoes Environmental Tests

USAF-North American GAM-77 Hound Dog missile undergoes simulated weather tests at Eglin AFB, Fla.; systems check is made above in temperature ranges from —65F to 160F.

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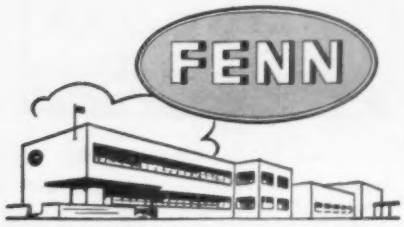

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airtight and watertight so no new techniques are needed for ignition below the air-sea interface. After ignition, a minimum chamber to nozzle exit pressure ratio of 2-3 to 1 is needed to permit supersonic flow. Given an internal burning pressure of 1,000 psi., a solid propellant rocket nozzle could function as deep as 680 ft. below the surface of the sea. Navy scientists call the energy loss to water friction negligible—equivalent to the work expended in lifting a 175-ft., 956,000-lb. vehicle 11 ft.

Launch of the wooden vehicle has shown that:

• **Underwater ignition** of a solid propellant rocket designed for air ignition poses no difficult problems.

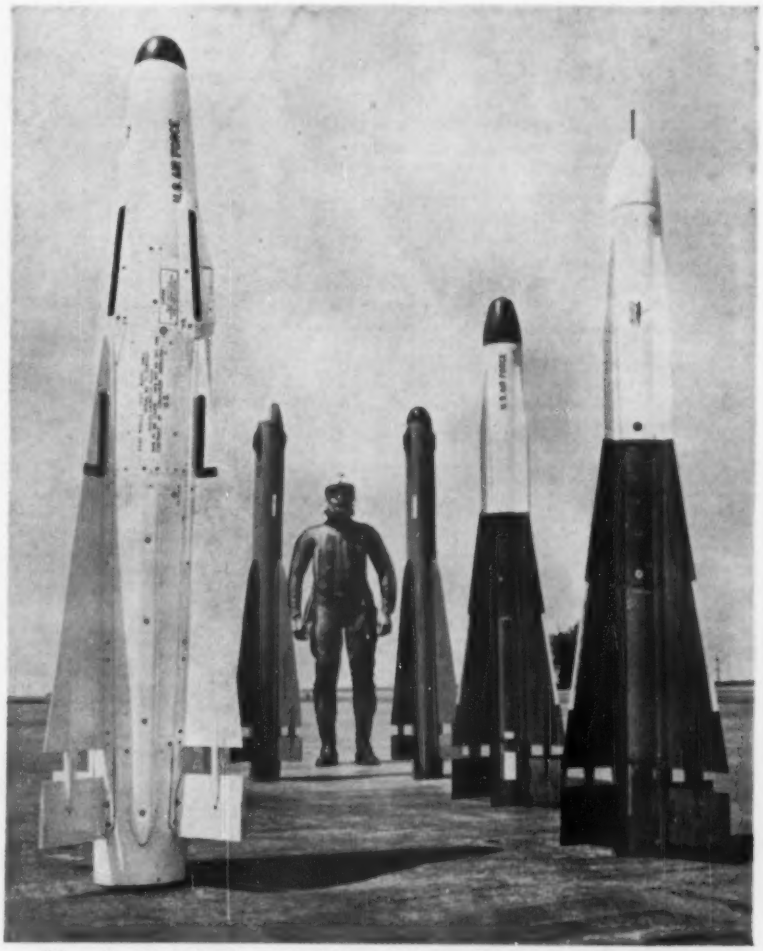
• **No water instability** is produced by the rocket exhaust.

• **Supersonic exhaust** is not choked by the inertia of water.

• **Water does erect and stabilize** suitably designed rockets in the same way that it stabilizes spar buoys long used by seamen. Demonstration launch was conducted in 30 kt. winds with gusts to 90 kt. and a heavy sea running.

Disadvantages conceded are incompatibility of liquid propellant rockets with the ocean environment and difficulty of access to lower stages when the rocket is in the water. The latter problem could be simplified by keeping most of the maintenance items in the top stage.

This could be carried and checked out aboard ship and installed just before launch by a special vessel, probably a small catamaran which would be moved over the floating booster and attached to it to eliminate relative motion during the mounting of the top stage.



Hughes Displays Air-to-Air Guided Missiles

Five air-to-air guided missiles manufactured for USAF by Hughes Aircraft Co. are displayed above. GAR-3A radar guided missile is at right, adjacent to the GAR-4A infrared missile. In the rear are the GAR-1D (right) and GAR-2A. In left foreground is the GAR-11 nuclear Falcon, the first air-to-air guided missile with nuclear capability (AW May 2, p. 32). GAR-3A and -4A have Mach 2 launch speed, high level of accuracy and ability to escape enemy decoys.

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- CLEAN WING, rear engine layout gives the silent zone seating which will be a passenger-specified must in the 1960-1970s.
- CLEAN WING FLIGHT is the flight of the future. It will be required from all modern airlines in their second-generation jet transports.

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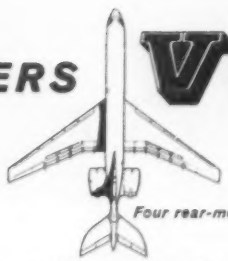
CLEAN WING FLIGHT represents an aerodynamic breakthrough, every aspect of which will be found in the Vickers VC10.

For details, contact Christopher Clarkson, U.S. representative, 10 Rockefeller Plaza, New York 20, N. Y.

VICKERS VC 10



Four rear-mounted Rolls-Royce Conway By-Pass Turbojets

Vickers-Armstrongs (Aircraft) Ltd., Weybridge, England • Member Company of British Aircraft Corporation

United Plans New Jet Orders in 1963-65

New York—United Air Lines looks to the 1963-65 period as the most likely time for any new round of jet transport orders, judging from the forecasts made by its president, W. A. Patterson, to the New York Society of Security Analysts here.

United's current jet orders were based on an over-all transportation forecast in which gross national product and population factors were included. This forecast then was broken down by type and it was estimated total domestic air traffic by 1965 would be 45 billion passenger miles, that over-all air traffic will grow 8% annually during this period and that United's traffic would grow 9.5% annually.

Laying out the frequency of service needed—United aims at doing 19% of the over-all transportation business—averaging the breakeven load factor for the year and other factors, United then ordered aircraft to fit this pattern for each year.

"If we are way off on the 45 billion forecast," Patterson said, "then we overordered. But our 45 billion is the most conservative in the airline business. Our own forecast shows we may be short of airplanes by 1963-65."

Patterson also noted that present orders carry through 1962 in commenting on future financing plans. When decisions are made for equipment in the 1963-65 period, he said, the financing will depend on conditions encountered then.

United has Douglas DC-8s in service and deliveries of 18 Boeing 720s are beginning. Patterson's description of DC-8 transition problems—especially cases of small, inexpensive parts as hydraulic seals grounding a multi-million dollar aircraft—echoed those of other operators. The 720 transition should be less difficult, particularly in respect to training where delays occurred in the DC-8 introduction because of unfamiliarity with the aircraft's training requirements, Patterson said.

The Sud Caravelle, United's third jet transport type on order, was on United's jet planning list eight years ago as a 30-plane item, Patterson added, but was envisioned at that time as a turboprop. After seeing the pure jet, United dropped all thought of propellers since it believed the public would insist on traveling by turbojet.

The DC-8 provides a long-haul, high density market aircraft. The 720 fills the shorter range but still high density markets. Lastly the Caravelle fits the lower density market where a 720 might be able to carry all the passengers generated in one day but where two schedules are needed a day to produce this number of passengers. Here, Patterson said, the smaller Caravelle can be operated more economically on multiple schedules. United has 20 Caravelles on order.

Patterson said United has recovered its available capacity position in the transcontinental market, lost after other carriers put jets into service. Like other airlines, United showed a first quarter loss—totaling $2.7 million—which Patterson said was disappointing but no surprise. He blamed it on mechanical and training problems, especially in scheduling aircraft for training, bad weather and the unfavorable public impact of accidents. United has deferred

United Airlines' Forecasts

Capacity Forecast

Year & Quarter	Available Seat Miles (millions)	Per Cent Change From Year Earlier Period	Per Cent Jet Seat Miles of Total
1959—4	1,744	—13.4	8.6
1960—1	1,784	—8.1	22.9
—2	2,182	+7.6	35.9
—3	2,530	+24.7	46.4
—4	2,469	+41.6	58.2
Year—1960	8,965	+16.1	42.4

Projected Capital Expenditures, Debt Service and Cash Flow From Operations

	Capital Expenditures	Debt Service[1]	Cash Flow[2]
	(000)	(000)	(000)
1960	$138,320	$10,613	$60,685
1961	138,702	13,943	76,022
1962	17,156	15,047	74,780
1963	11,814	36,726	67,616
1964	12,221	35,678	59,370
1965	12,751	34,339	49,102

[1] Interest and principal repayment.

[2] Depreciation, amortization, deferred tax accrual, and other; exclusive of retained earnings and proceeds from sale of surplus aircraft.

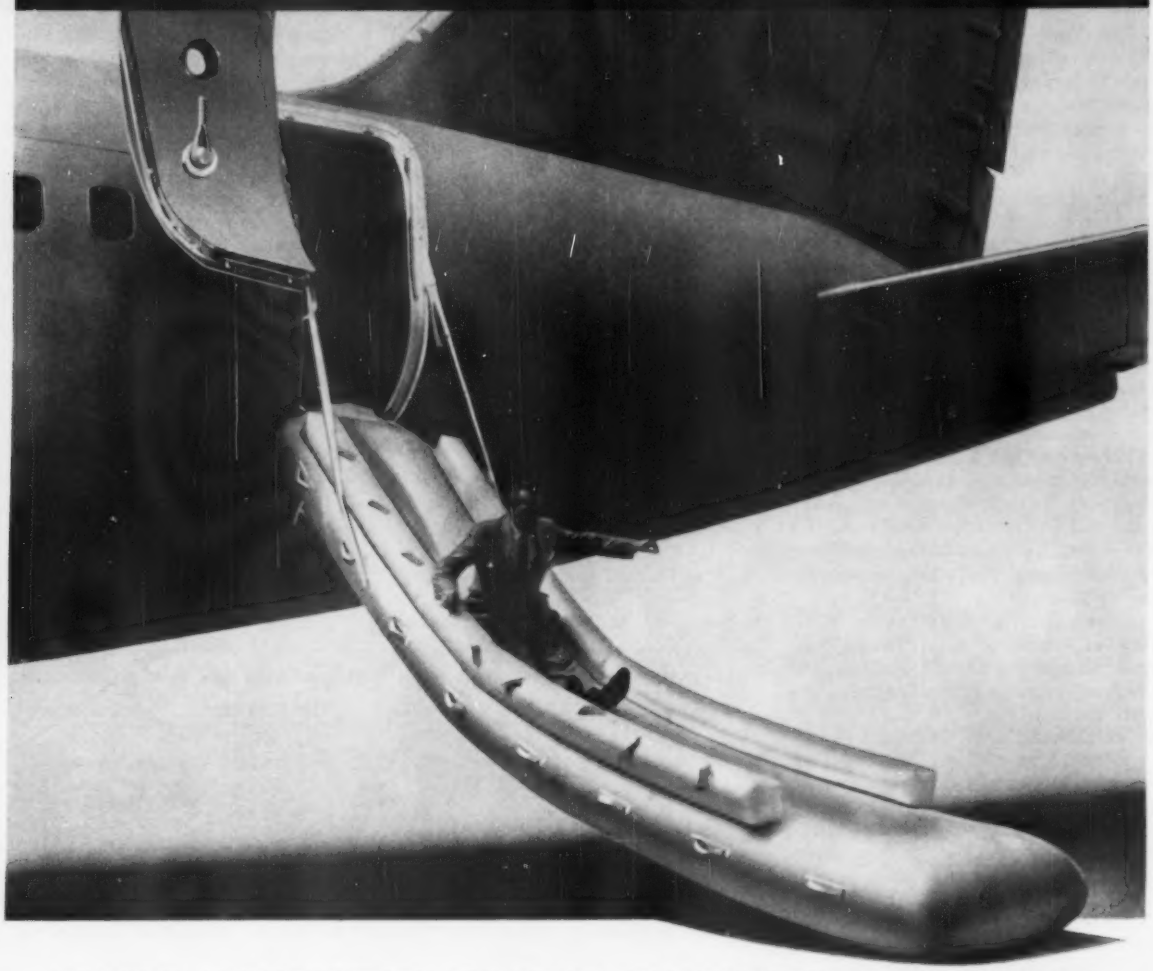
Projected Debt Service

	Debenture Repayment	Bank Loan Repayment	Interest Expense	Total
	(000)	(000)	(000)	(000)
1960	$2,592	.....	$ 8,021	$10,613
1961	2,592	.....	11,351	13,943
1962	2,592	.....	12,455	15,047
1963	2,592	$22,608	11,526	36,726
1964	2,592	22,609	10,477	35,678
1965	2,592	22,609	9,138	34,339

Projected Capital Expenditures

	Flight Equipment	Construction	Ground Equipment	Total
	(000)	(000)	(000)	(000)
1960	$123,104	$5,791	$9,425	$138,320
1961	125,166	8,503	5,033	138,702
1962	8,432	6,350	2,374	17,156
1963	4,198	5,122	2,492	11,814
1964	4,347	4,979	2,895	12,221
1965	4,228	5,570	2,953	12,751

ESCAPE SLIDE / another product of Air Cruisers research



NEW ESCAPE SLIDE SAFETY FEATURE

This flexible escape slide developed by Air Cruisers for jet airliners provides rapid and safer emergency evacuation of passenger aircraft, particularly at extreme aircraft attitudes.

The passenger's speed of descent is automatically reduced by his own body weight bending the last portion of the flexible slide closer and closer to a horizontal attitude as he nears the ground. Rate of descent is virtually stopped as the passenger eases off the final few feet of slide resting parallel on the ground.

Simple to operate, Air Cruisers escape slides are standard equipment on many turbine-powered military and commercial aircraft.

The Air Cruisers jet pump, which produces rapid inflation vital to the fast, dependable operation of escape slides, is yet another contribution toward better survival equipment by America's most experienced fabricator of inflatables from rubberized nylon materials.

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Supersonic PRs

Supersonic transports do not impress United's W. A. Patterson as being around the corner. Talk about supersonic transports, he told the New York Society of Security Analysts, seems to get started in the public relations department, maybe in a company that missed out on the 707 or DC-8.

"The PR man goes into the president and talks about image," Patterson said, "and the company president says, 'Okay, give them the business on a supersonic transport.'"

Or perhaps an airline has not been doing so well and it has a route application up for consideration. "It needs to make some news," Patterson said, "so it says it will put a supersonic transport on the route."

$3 million in transition costs for long term amortization.

United now has 22 DC-8s, four more than its contract with Douglas called for.

Production will be slowed during this month but is expected to pick up by July, Patterson said.

Competition is being felt from other airlines with new route awards and from foreign carriers newly certificated into certain transcontinental operations. The latter have no cabotage rights, Patterson noted, but they do take away passengers United might have carried to the international gateways, such as New York. Though not paying the cost of operation for foreign carriers, this loss is coming "off the top" for United.

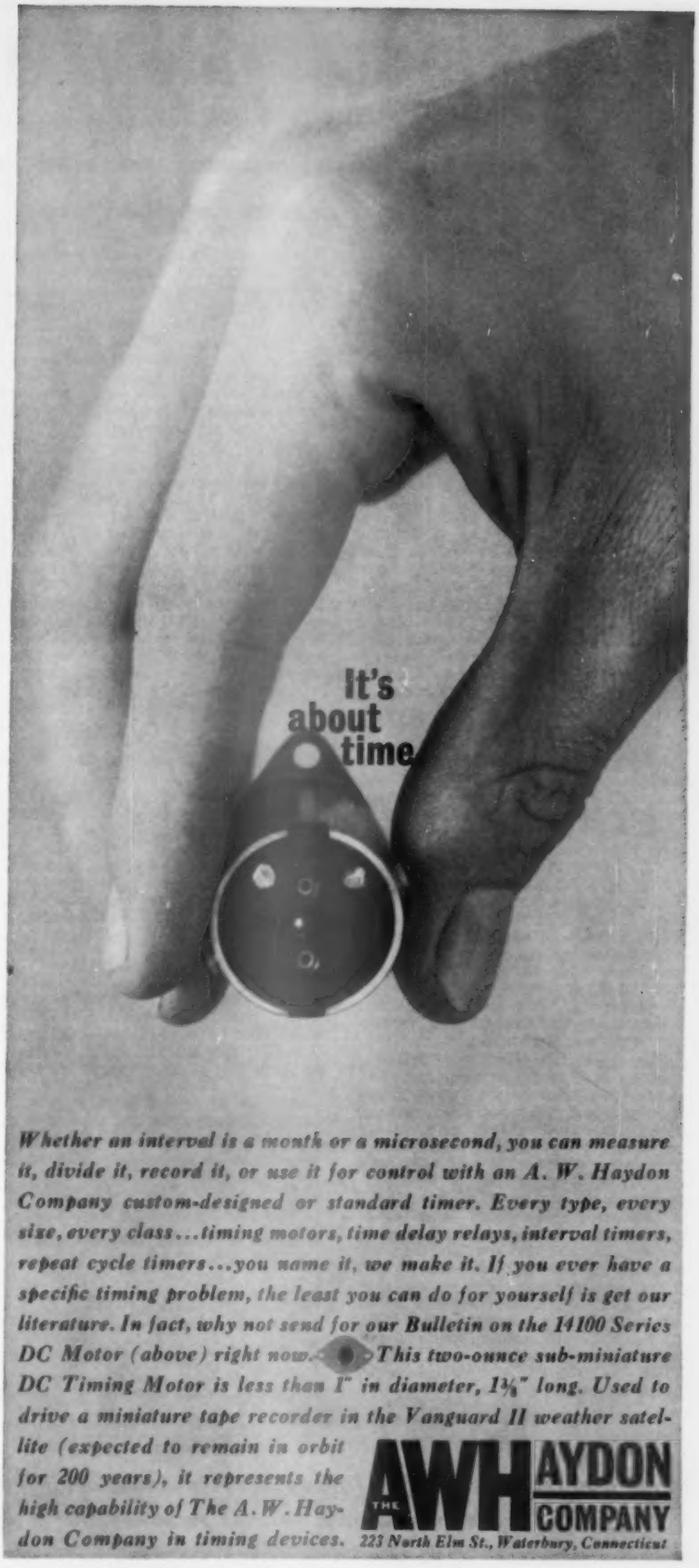
Similarly, American Airlines' entry into San Francisco cost United $550,000 of revenue in April. "This was sure off the top as far as we were concerned," Patterson said. "Otherwise this would have gone to net."

Why, Patterson asked, does United then go on making applications for new routes when it appears the airline has a problem because of excess amounts of competition now? "We file," he said, "because we feel lightning may strike." The chance always exists that United might get the next award.

Capital's Plight

Capital Airlines' current plight reflects the route award philosophy of the Civil Aeronautics Board, Patterson declared. "With each route extension they would say, 'This one will cure you, now you'll be a big, healthy boy.' And it led Capital down the road to where it is today."

In Patterson's opinion, the Capital situation—unfortunate as it is—may go a long way to cure the problem of excessive route awards. The question of mergers was brought up by one analyst, and Patterson added this footnote:



Whether an interval is a month or a microsecond, you can measure it, divide it, record it, or use it for control with an A. W. Haydon Company custom-designed or standard timer. Every type, every size, every class...timing motors, time delay relays, interval timers, repeat cycle timers...you name it, we make it. If you ever have a specific timing problem, the least you can do for yourself is get our literature. In fact, why not send for our Bulletin on the 14100 Series DC Motor (above) right now. This two-ounce sub-miniature DC Timing Motor is less than 1" in diameter, 1⅛" long. Used to drive a miniature tape recorder in the Vanguard II weather satellite (expected to remain in orbit for 200 years), it represents the high capability of The A. W. Haydon Company in timing devices.

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3M Materials Memo

News of material for the aerospace industry—from the 27,000 products of the 3M Company

■ FIRESIDE FASHIONS

You might not want to wear it in the Easter Parade, but a suit made of "Scotch-Shield" Heat-Reflective Fabric is in good taste for strolling through infernos. Such suits have been really hot items among fire fighters, both in the military and civilian life for some time now. More recently, in the form of sleeves, they've been bouncing heat off of expensive umbilical cables on the launch pads of some of our larger missile systems. They're a natural, too, as protective shrouds and bags for controls or instrumentation components – on the pad, or in the missile itself.

Resistance of these fabrics to radiant heating is well illustrated by this test performed in our Reflective Products Laboratory. A Globar heating element radiating at 2600° F. was placed at the one focus of an elliptical reflector. The sample of "Scotch-Shield" fabric was placed at the other focus. Even after 2 or 3 minutes of exposure, no burn-through took place. Under identical conditions, even flameproofed conventional fabrics disintegrate in seconds. An even more vivid test took place when an imaginative laboratory technician entered a blazing furnace carrying a raw T-bone steak on a platter. When he emerged minutes later, the sizzling steak was done to a turn.

The key to this phenomenal performance lies in the micro-thin aluminum film securely deposited on the surface of the light weight flame proof cloth backing. This finish, reflecting more than 90% of all radiant energy, unlike heavier aluminum foil won't crack or peel away from the backing. Furthermore, it doesn't detract from the original drape of the fabric or add noticeable weight. Those fabric backings available as standard products are the cotton, glass, and asbestos combination, the herringbone asbestos, and flame proofed rayon. If these don't suit your particular needs, special base fabrics are available on minimum yardage basis. If "Scotch-Shield" kindles your imagination, why not check with your REFLECTIVE PRODUCTS representative, or fill in the coupon below?

■ YOUR BIRD CARRYING A TORCH?

It might be doing just that, if you're still using conventional encapsulating resins on its hot little electronic innards. Of course, finding a truly flame proof resin system hasn't been an easy task. That is, not until "Scotchcast" XR-5019 entered the scene. This new two-part flexible epoxy resin system is so flame proof that it doesn't burn, even when given all sorts of encouragement. For example, in the Manson flammability tester – one that's really a scorcher – XR-5019 beat the standards of NEMA for non-flammable resins by a substantial margin. In this test, where the goal is to get the lowest possible number, values of 0.55 to 0.80 were achieved by XR-5019. These figures can be compared to a value of 6.2 for a conventional casting resin, which, incidentally, also passes the flammability requirements of Mil I-16923C. One manufacturer enthusiastically reports that XR-5019 insulated transformers have met the flammability requirements of even Mil T-27A without a waiver, which is something of a "first."

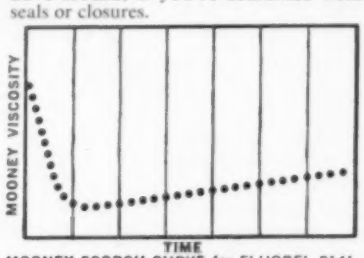
But this versatile resin system doesn't put all its eggs in one basket. In a thermal shock test developed by 3M, the resin cured around a ¼" metal insert is recycled between 130° and –55°. XR-5019 was cycled for ten times, with no failures. And its virtues don't end there. It features low impregnating viscosity and high adhesion to most metals. Its pot life of 3 to 4 days after mixing is nothing to overlook, either. Needless to say, these advantages are not offered at the sacrifice of electrical properties. Why not contact your local ELECTRICAL PRODUCTS representative, or check the box below for additional information?

■ SOME GUM!

A real aristocrat among synthetic elastomers is our CHEMICAL DIVISION'S new "Fluorel" 2141 Brand Elastomer. This fully saturated polymer is fluorinated to the hilt – containing greater than 60% fluorine by weight. Once you've been exposed to "Fluorel's" remarkable stability you'll realize that the fluorine is not along just for the ride.

Chemical stability is just one area in which it takes the blue ribbon. It resists almost all fuels, lubricants, and hydraulic fluids currently being used or developed for rocket and missile systems, even the high energy fuels of the boron type. It takes hot oils, many organic solvents, as well as strong inorganic acids and bases in its stride. Nor does it have to be pampered, as far as outdoor weathering is concerned.

High temperature is no enemy to "Fluorel," either. It performs under continuous long-time service at 400° F. without marked degradation. Under some conditions for reduced periods of exposure, temperatures above 600° F. can be tolerated. Then of course there's the fringe benefit of its excellent resistance to compression set, which is a handy property to have around, if you're concerned with seals or closures.



MOONEY SCORCH CURVE for FLUOREL 2141

Offering properties like these, you might expect that "Fluorel" would be a real prima donna when it comes to compounding–tain't so! It's easily processed on standard rubber compounding equipment with a Mooney Scorch rating ideal for the rubber processor – can be molded, extruded, and adhered to metals. It's natural for application to O-rings, gaskets, tubing, expellant bladders, fuel cells, and countless other demanding areas.

For a complete brochure on properties and handling of "Fluorel," contact your Chemical Division representative or check the coupon below.

And if you have questions on any of the items mentioned here, or would like to know what else 3M makes – or could make – for your needs, mail coupon.

3M Company, Missile Industry Liaison – Dept. VAC-50
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Please send more information on ☐ "Scotch-Shield" Heat-Reflective Fabric
☐ "Scotchcast" XR-5019 ☐ "Fluorel"

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3M COMPANY

MISSILE INDUSTRY LIAISON

"We're not going to be interested in mergers suggested by the government to bail the government out of the mistakes it began making in 1955."

Patterson also touched on the flight crew situation by pointing out he would not argue that the captain responsible for safety of a $5 million jet airliner and its passengers was worth every cent of his salary. "I'll only argue, 'Are you giving me everything you should?'" Patterson said.

He did not appear strongly concerned about the crew complement issue. (United has required its flight engineers be pilot-qualified and offered training to those who were not.) One organization signed a five-year agreement not to have engineers pilot qualified, Patterson said, then was faced with pilot demands for a third pilot in the cockpit, and wound up with four men in the cockpit.

"That's not featherbedding," Patterson asserted. "The pilots didn't ask for a fourth man. Who signed that five-year agreement?"

Lockheed Will Pay 2% Stock Dividend

Lockheed Aircraft Corp. will pay a 2% stock dividend instead of cash for the second quarter, not only because of need to retain capital funds for use in the business but also because of uncertainties as to total costs that may be required in the current Electra turboprop transport investigation.

Though sales increased to more than $330 million for the first quarter from $281 million for the same period last year, earnings declined one third to $2,750,000, or 38 cents a share compared with 61 cents last year. Lockheed's per share earnings of $1.24 for 1959 barely covered its $1.20 annual dividend and this probably was a factor in the decision to pay in stock.

Three other major aerospace companies reported first quarter results:

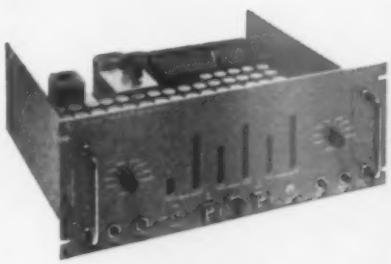
• **Boeing Airplane Co.** reported earnings increased from $1,719,175 or 22 cents a share to $4,045,179 on sales of $395,709,576. Charges against earnings on the 707 program declined slightly, but still totaled $11.3 million. Backlog as of Mar. 31 was $1.9 billion.

• **Martin Co.** sales for the first quarter ended Mar. 31 rose to $140,410,175 from the corresponding 1959 period figure of $122,159,105. Net income for the 1960 first quarter was $3,488,112 or $1.13 a share compared with $3,038,470 or 99 cents a share for the 1959 first quarter.

• **United Aircraft Corp.** reported sales of $273,904,687 compared with $250,279,610 for the first quarter last year. Earnings declined from $8,033,515 or $1.20 a share to $6,431,223 or 95 cents a share largely because of company

MARK TIME

TO AN ACCURACY OF 1 SECOND A MONTH



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ANNOUNCING A NEW CORPORATE NAME

for The Garlock Packing Company

Garlock Inc. becomes the new name for The Garlock Packing Company, Palmyra, N. Y., to reflect more accurately its broad diversification of products and markets.

Originally established to manufacture mechanical packings, Garlock now produces over 2,000 different styles of packings, gaskets, seals, molded and extruded rubber and plastic products for every major industry.

The new corporate name, Garlock Inc., more closely identifies this 73-year-old company with the growth and development of its product lines. *Today, industry goes to Garlock for such widely diversified products as:*

- Hydraulic-Pneumatic Packings
- Oil and Grease Seals
- Gasketing and Expansion Joints
- Braided Packings
- Molded and Extruded Rubber Parts
- Plastic Stock Shapes and Fabricated Parts
- Mechanical Seals for Rotating Shafts
- Metal Packings
- Leather Packings
- Electronic Components
- Dry Bearing Materials
- Fluorocarbon Tank Linings
- Missile and Rocket Components

To help you in selecting or applying these products, Garlock offers the services of over 126 thoroughly-trained sales engineers, 175 electronic component manufacturers' representatives, 180 authorized bearing distributors and 69 foreign distributors. Conveniently located warehouses and stocking points assure Garlock customers of prompt delivery.

At Garlock Inc., design and development of new or improved products and materials is an ever-present objective. To this end Garlock maintains extensive research and laboratory-test facilities. In addition, Garlock engineers and chemists are always ready to work with you in seeking solutions to tough application problems.

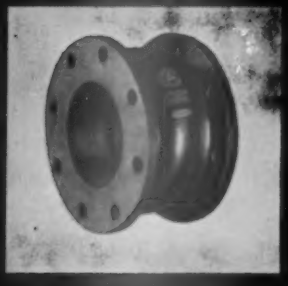
GARLOCK

To find out more about "the new Garlock," call the nearest of our 26 sales offices, or write to Garlock Inc., Palmyra, N. Y. *To assure prompt attention,* please refer to *Garlock Inc.* on all future correspondence and orders.

Canadian Div.: Garlock of Canada Ltd.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Hydraulic-Pneumatic Packings

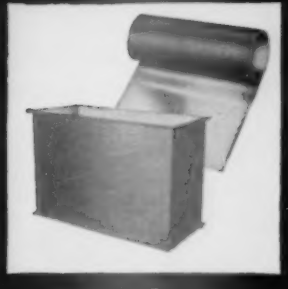


Expansion Joints

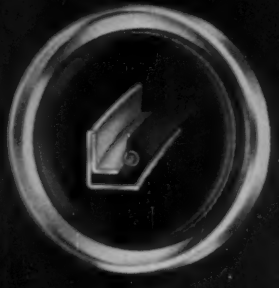
Molded and Extruded Rubber Parts

Plastic Stock Shapes and Fabricated Parts

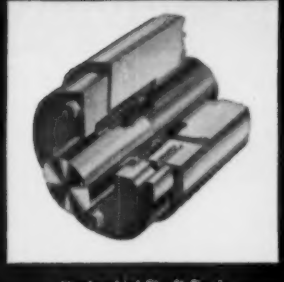
Braided Packings



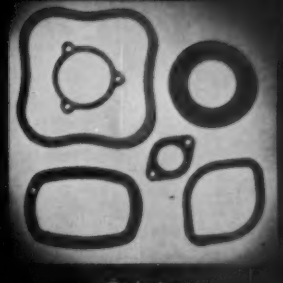
Fluorocarbon Tank Linings



Oil and Grease Seals



Mechanical Shaft Seals



Gasketing

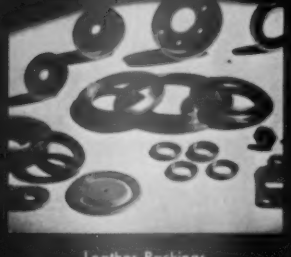
Spiral Wound Gaskets

Metal Packings

Dry Bearing Material

INC.

Missile and Rocket Components



Leather Packings

Electronic Components

America's biggest, most versatile satellites

sponsored research and development projects. Backlog was $1 billion.

Lockheed backlog of the corporation, Chairman Robert E. Gross told stockholders at the annual meeting, stands at $1.1 billion, up about 15% from the same period last year, but slightly below the total as of the first of 1960.

Commercial transport sales accounted for only one-eighth of the total sales for the first period, Gross said, adding that the Electra program has been a drain on profits made by the other seven-eighths of the corporation's revenue-producing activities.

Lockheed delivered 18 Electra transports to 13 different customers in the first quarter but the total sales price was $2.3 million less than the recorded costs of construction. While price of planes to the customer is fixed at the time of contract signing, Gross indicated that Lockheed cost pricing is set according to the number of firm orders in hand as of the end of the year. Like other manufacturers, Gross said, Lockheed overestimated the total potential market at the beginning of the turbine transport program (AW May 2, p. 177).

Concerning future Electra production, Gross said 30 of the planes will be delivered between now and November, on a declining production rate. However, close on the heels will come production of the Navy P3V-1, the Navy's anti-submarine version of the Electra. First production plane of this type will fly next spring.

The company's fleet ballistic missile Polaris will be, according to Gross, a production item. Gross pointed out that by the end of 1960 there will be 32 operational Polaris missiles aboard submarines, adding that nine Polaris-carrying subs are being built and that the Navy has indicated a long term goal of 45 Polaris submarines, each carrying 16 missiles.

Citing the certification of the Lockheed-Azcarate Model 60 (AW Apr. 25, p. 95), and its imminent production, Gross declared that Lockheed's subsidiary, Pacific Finance Co., has been considering entering the field of financing purchases of the utility aircraft.

Acquisitions And Mergers

Composite Industrial Metals, Inc., Providence, R. I., has acquired A. Holt & Co., manufacturer of gold fill and gold rolled plate which will be used in advanced developments of solid and laminated materials for semiconductor devices and other electronic uses.

The Budd Co., Philadelphia, Pa., has acquired the assets of Metrol, Inc., of Pasadena, Calif., to expand Budd's Instrument Division non-destructive testing equipment line. It will operate as a division department; Richard Hochschild, Metrol president, will join the Budd Co. staff.

Jack & Heintz, Inc., has purchased assets and manufacturing rights of Roto-Lock Couplings, Inc., South Gate, Calif., to extend the company's diversification plans. Roto-Lock's inventory and tooling will be moved to Cleveland, Jack & Heintz headquarters.

Financial Briefs

Idaho Maryland Mines Corp., Glendale, Calif., reports that 1959 sales and earnings were the highest since it ended mining activities in 1957 and began designing and producing aircraft and missile controls. Sales in 1959 were $3,398,455 compared with $1,765,700 in 1958. Earnings in 1959 totaled $214,405 compared with a loss of $318,897 the year before.

Gyrodyne Co. of America, Inc., backlog totaled $8,800,000 in April, twice

as much as a year ago. Sales for the first 10 months of the fiscal year ended Apr. 30 were about $2,187,000.

New Offerings

Englehard Industries, Inc., Newark, N. J., principally engaged in manufacturing and selling products made of or containing precious metals, and in refining and selling such metals. Offering is 400,000 shares of common stock, for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $2 million will be used to reduce an outstanding 4½% note; a portion will be used to reduce short term indebtedness to banks; the balance will be added to working capital.

C-E-I-R, Inc., Arlington, Va., engaged in commercial electronic computer service, offering its facilities to government, industry and commerce. Offering is 122,000 shares of Class A voting stock, to be offered for subscription by holders of outstanding Class A voting and Class B non-voting stock, at the rate of one new share for each four shares held; record date, subscription price and underwriting terms to be supplied by amendment.

The company is engaged in an expansion program and has made arrangements to acquire Telecomputing Services, Inc., Los Angeles, and is planning to expand its Arlington facilities and to open centers in New York, Houston and Los Angeles. Proceeds of the present offering will be used to the extent necessary to defray the full cost of the acquisition of Telecomputing Services, and the balance will be applied to other phases of the program. Required additional funds will be obtained largely from bank loans and other financing as deemed advisable.

Teleregister Corp., Stamford, Conn., engaged in furnishing data processing, dissemination and display devices, including electronic stock and commodity quotation service for use by the financial community, and special purpose on- and off-line stored program and fixed program electronic data processing systems for industry in general. Offering is $6 million of 6% subordinated sinking fund debentures, due May, 1980 (with attached warrants), and 240,000 shares of common stock, for public sale in units of a $1,000 debenture (with five year warrants to purchase 20 common shares initially at $15 per share) and 40 shares of common stock; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $6,115,000 will be used to pay off the current portion of borrowings under a credit arrangement with a bank, and the balance will be applied to the company's construction program of approximately 50 teleregister boards in 1960.

Schaevitz Engineering, Pennsauken, N. J., engaged in the design, development and manufacture of measuring, indicating, recording and controlling devices for industrial and military applications. Offering is 100,000 shares of Class A common stock at $3 per share. Proceeds will be used to increase the company's current activities, to take advantage of diversification opportunities, and to increase net working capital.

The 100,000 shares are part of an authorized issue of 900,000 shares of 10 cents par value common stock.

Vector Manufacturing Co., Inc., Southampton, Pa., engaged primarily in the development, engineering, manufacturing and sale of radio telemetry equipment and systems consisting of electronic airborne and ground station instrumentation for use in space probes, satellites, rockets, nuclear weapons and in the aircraft and missile industries. Offering is 250,000 shares of common stock: 100,000 shares to be offered for public sale by the issuing company, and 150,000 outstanding shares by the holders thereof. Offering price and under-

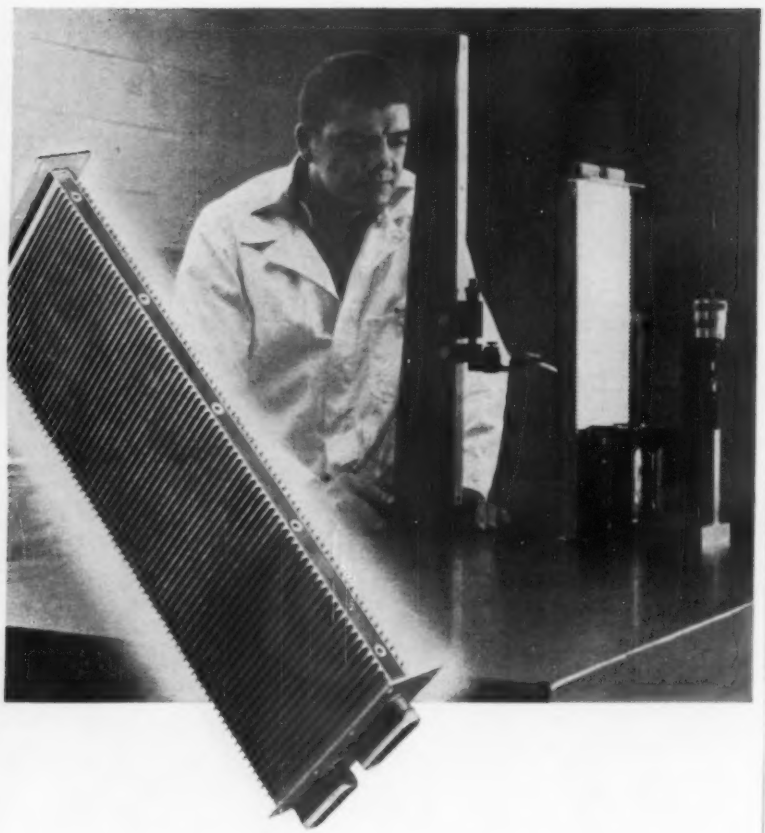
are being built at Satellite Center, U.S.A.

Satellite Center, U. S. A., is located in the San Francisco Bay area at Sunnyvale, California. From Lockheed's vast new Satellite Systems Building come the Agena satellite of the Air Force Discoverer program; the Agena B planned for lunar and deep-space probes, and the satellites for the Air Force's Midas (missile defense alarm system) and Samos (strategic surveillance system).

LOCKHEED MISSILES & SPACE DIVISION SUNNYVALE CALIFORNIA

COMPLETE CAPABILITY

hma



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Advanced-type HMA cold-plate heat exchangers are setting new standards of superior performance at low over-all costs. Greater effectiveness and lighter weight . . . reasons why compact, highly-producible HMA air-heat sinks are a popular choice for more efficient heat transfer. Also, HMA customers get single source responsibility, as HMA designs, manufactures (including dip-brazing) and tests in its newly-expanded facilities. Precision units can be supplied to meet your specific requirements.

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writing terms to be supplied by amendment. The selling stockholders have or will donate 100,000 shares to the company for the purpose of this offering, so the sale of the stock involves no increase in the outstanding shares. Proceeds of the sale of the 100,000 shares will be used for various purposes in conjunction with the company's expansion program, which includes a new Space Instrumentation Center being constructed at Trevose, Pa.

Waltham Precision Instrument Co., Inc., Waltham, Mass., engaged in the manufacture and sale of time delay mechanisms for mortar shells, fuzes for 20 mm. shells, aircraft clocks, lensatic compasses, gyroscopes, repair parts for civilian watches and other items. Offering is 700,000 shares of common for subscription by common stockholders; record date, subscription rate and subscription price to be supplied by amendment. Certain individuals have or will agree to purchase an unspecified number of shares of stock not purchased by shareholders.

In February, 1960, the company acquired all the outstanding stock of Electro-Mec Laboratory, Inc., Long Island City, N. Y., a manufacturer of potentiometers and digitometers, and in March contracted to purchase all the outstanding stock of Boesch Manufacturing Co., Inc., Danbury, Conn., a manufacturer of toroidal coil winding machines. Proceeds will be used to pay the balance of the purchase price for the Boesch stock; to pay the 5% chattel mortgage note held by the Secretary of the U. S. Treasury as assignee of the Reconstruction Finance Corp.; to pay the 6% secured notes issued as part payment for the stock of Electro-Mec Laboratory. Any balance will be for working capital and other corporate purposes.

Espey Mfg. & Electronics Corp., Saratoga Springs, N. Y., engaged in the design and manufacture of electronic components and electromechanical devices, the major products being specialized electronic power supplies and various types of transformers and other iron core components used in missiles, computers, radar, sonar and other equipment. Offering is 80,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $450,000 is to be used for the estimated preproduction costs for the company's proposed semiconductor operations; $200,000 to repay a bank loan and to discharge $25,200 of 6% debentures, plus $9,000 of interest held by Sol Pinsley, a company officer. The balance of the funds are to be added to working capital.

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Stratoflex's new Stratolok series of self-locking nuts is based on a 3-way mechanical displacement of threads. The Stratolok locking element permits free hand starting and insures that the lock is fully engaged before the nut is completely seated. When fully seated, the lock is retained.

Stratolok nuts meet all locking performance requirements of Specification MIL-N-25027. They are available in a complete range of sizes and are reusable and completely interchangeable with existing AN and MS nuts. Stratolok "S" series nuts, for temperatures up to 550°F, are Cadmium-plated steel; "CR" Series, for temperatures up to 800°F, are silver-plated stainless steel.

SF4-0

For complete information, write for Stratolok Bulletin S-8.

*Formerly SPS Self-Locking Nut

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Aerospace Firms List Executive Salaries, Bonuses With SEC

Washington—Following is a list of aerospace industry officers' and directors' salaries, bonuses and stock holdings for 1959 as filed with the Securities and Exchange Commission:

American Bosch Arma Corp.—**C. W. Perelle**, president and director, $130,000 salary and 20,000 shares of common stock; **C. A. Sharpe**, senior vice president, $54,333 salary with no stock listed; **V. Scherlemmer**, vice president, $45,666 salary with no stock listed.

Following directors were not paid a salary: **C. Allen, Jr.**, 50,214 shares of common stock owned by Allen & Co., of which C. Allen is a general partner; **F. W. Harder**, 10,000 shares of common stock; **J. L. Holtzmann**, 1,161 shares of common stock and 1,673 shares of common stock owned by Holtzmann's law firm; **R. F. Peo**, 665 shares of common stock; **M. L. Sindeband**, 131 shares of common stock; **C. G. Terry**, 725 shares of common stock; **G. C. Textor**, 134 shares of common stock; **W. S. Wasserman**, 4,279 shares of common stock.

American Machine & Foundry Co.—**C. L. Burgess**, president and director, $76,200 salary and 3,000 shares of common stock; **F. P. Downey**, vice president, $66,200 salary and 8,696 shares of common stock; **R. C. Gott**, executive vice president and director, $71,100 salary and 7,728 shares of common stock; **G. S. Hastings**, vice president and director, $32,250 salary and 1,020 shares of common stock; **G. S. Hills**, general counsel and director, $25,228 salary (also $118,872 paid to Rogers, Hoge & Hills for legal services during the year. G. S. Hills is a participating member of this firm), and 3,892 shares of common stock; **D. S. Meiklejohn**, treasurer and director, $53,900 salary and 5,000 shares of common stock; **M. Patterson**, chairman of the board, chief executive officer, vice president, director of International Cigar Machine Co. and director, $127,200 salary, 59,956 shares of common stock and trustee and residuary beneficiary of a trust of 37,208 shares of common stock registered in his name and trustee, but not residuary beneficiary, of two trusts totalling 38,936 shares of common stock.

W. B. Smith, vice chairman of the board and director, $48,000 salary and 13,120 shares of common stock; **M. D. Sprague**, vice president and director, $45,800 salary and 1,800 shares of common stock.

Following directors were not paid a salary: **G. Arents**, 93,600 shares of common stock; **M. McConnel**, 228 shares of common stock; **S. de J. Osborne**, 400 shares of common stock; **H. P. Patterson**, 1,862 shares of common stock, residuary beneficiary of a trust of 20,000 shares of common stock registered in his name and nonresiduary beneficiary of a trust of 965 shares of common stock registered in the name of his daughter as of Feb. 1, 1960; **R. P. Soule**, 1,400 shares of common stock.

Avco Corp.—**V. Emanuel**, chairman of the board, $180,000 salary, 50,214 shares of common stock and $100,000 worth of 5% convertible subordinated debentures; **K. R. Wilson, Jr.**, president and director, $129,166 salary, 16,000 shares of common stock and $4,000 in 5% convertible subordinated debentures; **J. R. Kerr**, vice president and director, $100,000 salary, 9,366 shares of common stock and $2,000 in 5% convertible subordinated debentures; **Dr. A. R. Kantrowitz**, vice president and director, $94,583 salary and 6,000 shares of common stock; **M. A. McLaughlin**, vice president, general counsel and director, $89,375 salary, 9,375 shares of common stock and $2,000 in 5% convertible subordinated debentures.

J. D. Shouse, vice president and director, $87,500 salary and 16,980 shares of common stock; **E. H. Blaik**, vice president and director, $79,116 salary and 1,000 shares of common stock; **W. A. Mogensen**, director with salary of $35,000 and 9,300 shares of common stock.

Following directors were not paid a salary: **G. E. Allen**, 2,500 shares of common stock and $3,900 in 5% convertible subordinated debentures; **I. B. Babcock**, 2,248 shares of common stock and $3,300 in 5% convertible subordinated debentures; **J. Bruce**, 3,000 shares of common stock; **M. W. Clement**, 1,050 shares of common stock and $2,000 in 5% convertible subordinated debentures; **C. C. Darling**, 7,000 shares of common stock and $10,000 in 5% convertible subordinated debentures; **R. H. Deetjen**, 2,500 shares of common stock and $5,000 in 5% convertible subordinated debentures.

R. L. Johnson, 1,500 shares of common stock and $1,500 in 5% convertible subordinated debentures; **H. H. Kahn**, 2,500 shares of common stock and $4,000 in 5% convertible subordinated debentures; **E. H. Litchfield**, 1,000 shares of common stock; **M. A. MacIntyre**, 100 shares of common stock; **J. A. McDougald**, 10,000 shares of common stock; **W. I. Myers**, 1,000 shares of common stock; **B. H. Namm**, 2,806 shares of common stock; **T. A. O'Hara**, 4,019 shares of common stock and $4,000 in 5% convertible subordinated debentures.

Boeing Airplane Co.—**W. M. Allen**, president and director, $124,519 salary and 12,561 shares of common stock; **W. E. Beall**, senior vice president and director, $87,882 salary and 5,499 shares of common stock; **F. P. Laudan**, vice president-manufacturing and director, $43,542 salary, 8,976 shares of common stock and $20,000 worth of company debentures; **E. C. Wells**, vice president-engineering, general manager of the Systems Management Office and director, $76,165 salary and 3,834 shares of common stock; **J. O. Yeasting**, vice president, general manager-Transport Division and director, $59,028 salary and 3,209 shares of common stock.

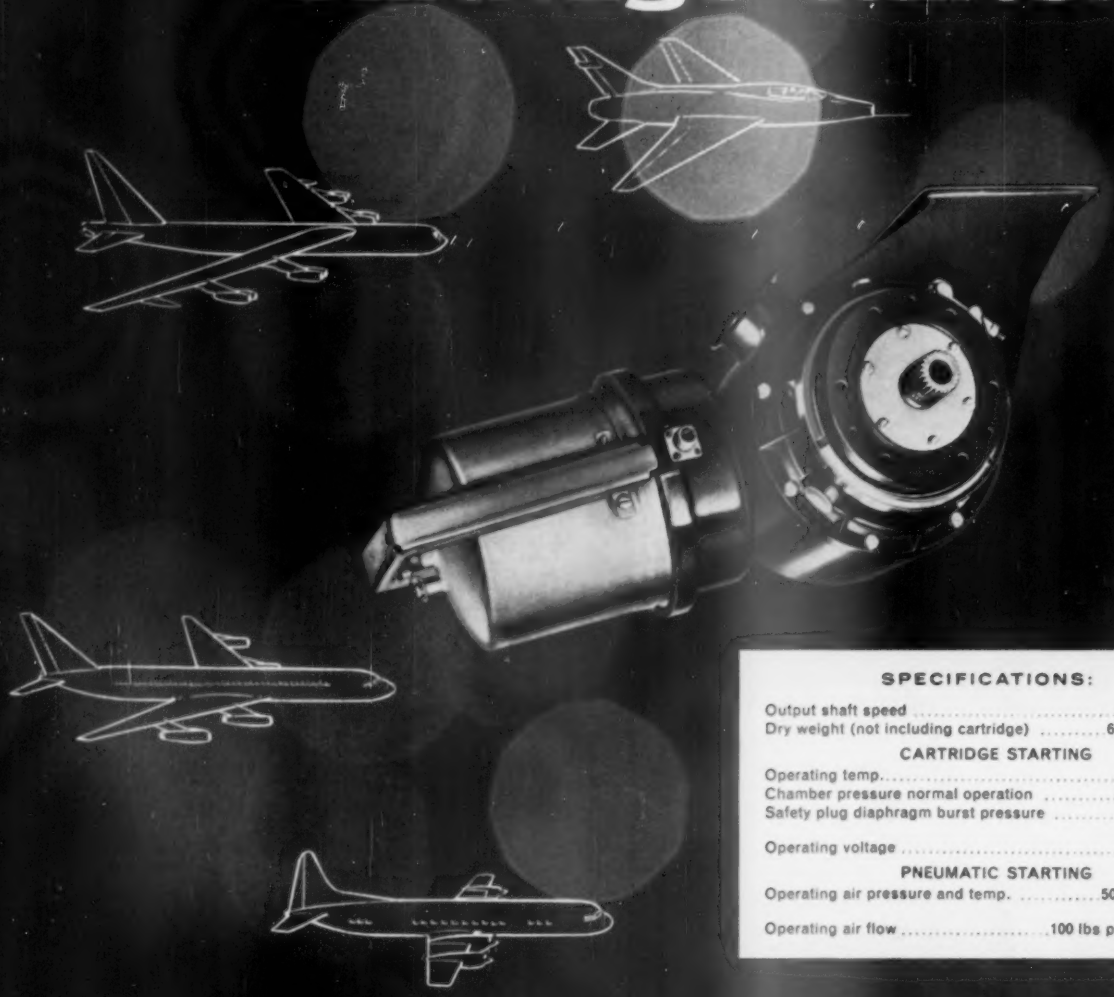
Following directors were not paid a salary: **D. Corbet**, 674 shares of common stock and $2,700 worth of company debentures; **C. L. Egtvedt**, chairman, 18,898 shares of common stock; **D. A. Forward**, 530 shares of common stock and $2,200 worth of company debentures; **A. L. Gates**, 648 shares of common stock; **P. Pigott**, 330 shares of common stock; **W. G. Reed**, 1,446 shares of common stock; **J. E. Schaefer**, vice chairman, 1,000 shares of common stock; **D. Schmitz**, 5,106 shares of common stock.

Borg-Warner Corp.—**R. C. Ingersoll**, chairman and director, $129,500 salary, 5,500 shares of common stock and 5,153 shares of stock in family holdings; **R. S. Ingersoll**, president, chief executive officer and director, $148,500 salary, 2,000 shares of common stock and 400 shares of common stock in family holdings; **L. G. Porter**, executive vice president and director, $126,500 salary and 2,164 shares of common

AiResearch Aviation Expands Facilities

Garrett Corp.'s AiResearch Aviation Service Division has leased an additional hangar and ramp (dotted line) at Los Angeles International Airport to accommodate a contract with Napier Engines, Inc. AiResearch will perform engine conversions for Napier turboprop-powered Convair 540 aircraft.

The only operational cartridge starter...



SPECIFICATIONS:

Output shaft speed	3000 rpm (max)
Dry weight (not including cartridge)	60.0 lbs (approx)
CARTRIDGE STARTING	
Operating temp.	−65° to 160°F
Chamber pressure normal operation	850 psi
Safety plug diaphragm burst pressure	2000 psig (nominal)
Operating voltage	15 to 32 volts
PNEUMATIC STARTING	
Operating air pressure and temp.	50 psia and 350°F (nominal)
Operating air flow	100 lbs per min (approx)

AIRESEARCH'S CARTRIDGE/PNEUMATIC STARTER *has completed more than 20,000 successful cartridge starts for the F-100, F-105 and Hound Dog missile applications.*

Completely fail-safe, this lightweight package is the only cartridge starter capable of full containment of a wheel hub burst.

The AiResearch starter is extremely flexible and compact, making it easily adapted to any jet engine envelope. For example, the same starter now used on the Hound Dog missile can be delivered immediately for use on the B-52 itself.

This self-contained, aircraft-installed starting system provides quick, dependable starts in any climate or location by means of high temperature cartridge gases *or* low pressure air such as supplied by an AiResearch gas turbine serving as an onboard pneumatic power source or conventional ground support unit.

The starter consists, basically, of an air turbine starter and a removable solid propellant cartridge chamber. Combustion of the cartridge directs high pressure gas against the turbine wheel, turning the output shaft. Overspeed is controlled by aerodynamic braking action of air compressed by radial blades on the other side of the turbine wheel.

This simple system consists of proven components with many thousands of hours of successful operating history. The pioneer and leading manufacturer of air turbine starters of all types for both military and commercial application. AiResearch has more than four years of cartridge experience and 12 years' experience in pneumatic starters.

Your inquiries are invited.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

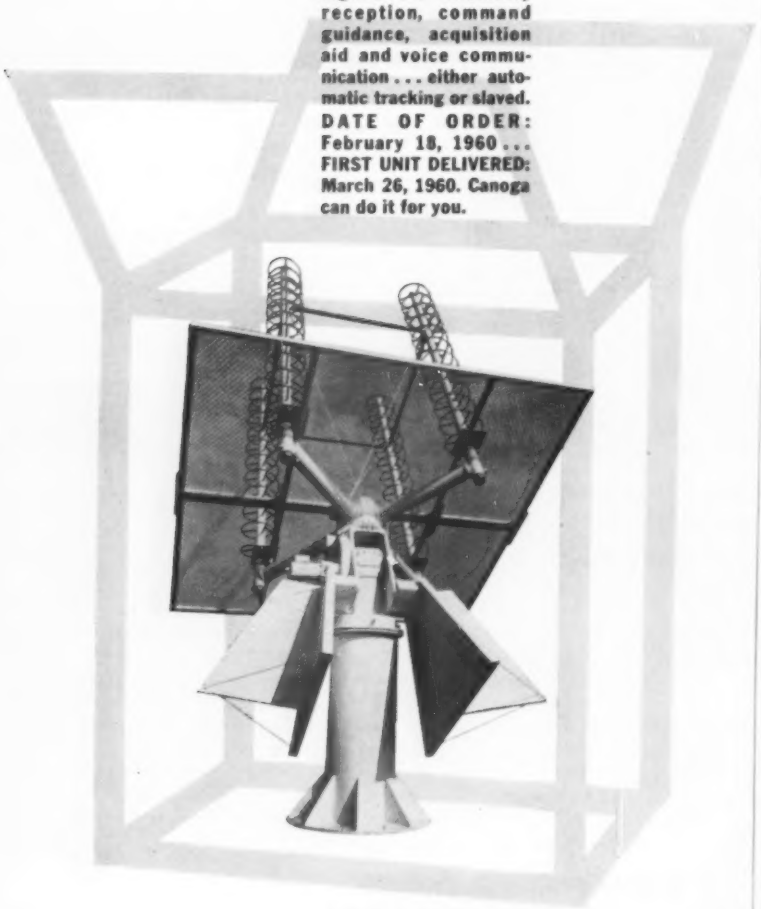
DELIVERED IN 37 DAYS:

...for Project Mercury... Canoga's Quad Helix telemetry receiving antenna, one of 50 units for Mercury's ground instrumentation antenna system, was developed, designed, manufactured and delivered in 37 days.

THE PEDESTAL ... an important advance in low-cost pedestal design. Balanced elevation yoke provides improved accuracy · Coax rotary joint rated at 10KW, CW · Adaptable for use with parabolic antennas up to 12 feet in diameter.

THE ARRAYS... Canoga Quad Helices are designed for telemetry reception, command guidance, acquisition aid and voice communication ... either automatic tracking or slaved.

DATE OF ORDER: February 18, 1960... FIRST UNIT DELIVERED: March 26, 1960. Canoga can do it for you.



canoga

CANOGA/A SUBSIDIARY OF THE UNDERWOOD CORPORATION · VAN NUYS, CALIFORNIA · FORT WALTON BEACH, FLORIDA

stock; **R. W. Murphy**, vice president, general counsel, chairman of the executive committee and director, $105,750 salary and 986 shares of common stock; **A. Steg**, vice president, treasurer and director, $97,500 salary and 2,200 shares of common stock; **E. S. Russey**, vice president, general manager of the Warner Gear Division and director, $127,500 salary and 3,131 shares of common stock.

Following directors were not paid a salary: **H. G. Ingersoll**, 5,035 shares of common stock, 200 preferred shares of stock in family holding and 1,468 shares of common stock in family holding; **E. F. Ball**, 23,500 shares of common stock and 49,902 shares of common stock in family holding; **C. S. Davis, Jr.**, 7,772 shares of common stock and 53,530 shares of common stock in family holding; **F. H. Davis**, 18 shares of common stock; **A. E. Duncan**, 13,564 shares of common stock and 3,947 shares of common stock in family holding.

J. R. Forgan, 200 shares of common stock; **G. A. Freeman, Jr.**, 100 shares of common stock; **J. E. Johnson**, 17,475 shares of common stock and 58,922 shares of common stock in family holding; **R. P. Johnson**, 29,100 shares of common stock and 34,100 shares of common stock in family holdings; **W. G. Karnes**, 100 shares of common stock; **J. Madden**, 100 shares of common stock; **G. S. Moore**, 100 shares of common stock.

Curtiss-Wright Corp.—**R. T. Hurley**, chairman, president and director, $329,500 salary and 15,500 shares of common stock; **G. R. Hill**, executive vice president-finance and director, $176,500 salary and 12,000 shares of common stock; **J. G. Byron**, executive vice president and director, $94,500 salary and 900 shares of common stock; **J. V. Miccio**, vice president, general manager-Wright Aeronautical Division and director, $115,972 salary and no stock.

Following directors were not paid a salary: **T. R. Berner**, 1,200 shares of common stock; **L. H. Campbell, Jr.**, 100 shares of common stock; **C. A. Dana**, 100 shares of common stock; **J. R. MacDonald**, 300 shares of common stock; **D. C. Power**, 100 shares of common stock; **S. R. Reed**, 300 shares of common stock; **L. H. Smith**, 100 shares of common stock.

General Electric Co.—**R. J. Cordiner**, chairman and director $279,974 salary, 46,722 shares of common stock and contingent interest in 31,463 shares of common stock; **R. Paxton**, president and director, $212,497 salary, 34,848 shares of common stock and contingent interest in 10,121 shares of common stock; **P. D. Reed** (retired 11/30/59), chairman of the finance committee, consultant to the chairman and director, $133,737 salary, stock not listed; **C. W. LaPierre**, vice president and group executive, $165,972 salary, stock not listed.

Following directors were not paid a salary: **S. S. Colt**, 3,170 shares of common stock; **D. K. David**, 600 shares of common stock; **C. D. Dickey**, 9,000 shares of common stock; **H. Ford II**, 100 shares of common stock; **J. Holmes**, 1,000 shares of common stock; **F. L. Hovde**, 10 shares of common stock; **G. W. Humphrey**, 100 shares of common stock; **J. E. Lawrence**, 100 shares of common stock; **G. H. Love**, 600 shares of common stock; **T. B. McCabe**, 2,500 shares of common stock; **N. H. McElroy**, 100 shares of common stock; **G. G. Montgomery**, 1,100 shares of common stock; **H. S. Morgan**, 9,000 shares of common stock; **R. T. Stevens**, 500 shares of common stock; **S. J. Weinberg**, 1,500 shares of common stock; **R. W. Woodruff**, 1,590 shares of common stock.

Grumman Reports Higher First Quarter Income

Bethpage, N. Y.—Grumman Aircraft Engineering Corp. reports an improved first quarter.

Net income was $1,946,740, up $895,457 over last year. Sales were $73,230,315, an increase of $12,460,000 over 1959's first quarter.

Airlines List Officers' Salaries, Bonuses

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensations, expenses and stock holdings for the year ending Dec. 31, 1959, as reported to the Civil Aeronautics Board:

Pan American World Airways, Inc.—J. T. Trippe, president and director, $100,000 salary, $2,350 bonus and indirect compensation, $6,379 expenses and 31,539 shares of common stock in name of others; **R. Lewis,** executive vice president-administration and director, $40,000 salary, $31,300 bonus and indirect compensation, $7,323 expenses and 2,075 shares of common stock; **W. L. Morrison,** executive vice president-Latin American Division and director, $40,000 salary, $27,000 bonus and indirect compensation, $12,982 expenses, 15,212 shares of common stock and 100 shares of common stock in name of others; **H. E. Gray,** executive vice president-Overseas Division and director, $40,000 salary, $30,500 bonus and indirect compensation, $4,458 expenses, 9,052 shares of common stock and $37,800 worth of debt securities.

R. B. Murray, Jr., executive vice president, $35,000 salary, $15,000 bonus and indirect compensation, $18,586 expenses, 375 shares of common stock and $2,600 worth of debt securities; **J. C. Leslie,** vice president, assistant to the president and director, $38,000 salary, $26,100 bonus and indirect compensation, $7,669 expenses and 4,500 shares of common stock in name of others; **H. J. Friendly,** vice president, general counsel and director (left company 9/30/59), $27,750 salary, $500 bonus and indirect compensation, $600 expenses and 10,710 shares of common stock; **H. A. Schneider,** vice president, general counsel and director (entered office 12/1/59), $2,750 salary, $2,100 bonus and indirect compensation, $142 expenses, 50 shares of common stock and 100 shares of common in name of others.

S. F. Pryor, vice president and director, $33,000 salary, $17,250 bonus and indirect compensation, $51,453 expenses and 15,432 shares of common stock; **F. Gledhill** vice president and director, $38,000 salary, $27,300 bonus and indirect compensation, $7,920 expenses, 5,202 shares of common stock and $10,000 worth of debt securities; **W. G. Lipscomb,** vice president-traffic and sales, $38,000 salary, $28,000 bonus and indirect compensation, $10,322 expenses and 11,908 shares of common stock.

J. B. Gates, vice president-development, $33,000 salary, $14,000 bonus and indirect compensation, $3,918 expenses and 1,000 shares of common stock; **A. P. Adams,** vice president, $32,000 salary, $15,000 bonus and indirect compensation, $13,307 expenses, 2,500 shares of common stock and $7,100 worth of debt securities; **E. Ballader,** vice president, $30,000 salary, $10,000 bonus and indirect compensation, $4,072 expenses, 14,625 shares of common stock and 5,660 shares of common stock in name of others; **J. C. Pirie,** vice president and associate general counsel, $26,500 salary, $10,000 bonus and indirect compensation, $2,034 expenses and 2,380 shares of common stock.

C. M. Young, vice president (left company 1/31/59), $1,485 salary, no bonus or indirect compensation, $905 expenses and 3,025 shares of common stock; **R. B. Adams,** vice president, $30,000 salary, $12,000 bonus and indirect compensation, $9,585 expenses, 3,040 shares of common stock and $21,700 worth of debt securities; **A. J. Kelly,** vice president, $22,488 salary, $5,000 bonus and indirect compensation, $5,307 expenses and 1,158 shares of common stock; **H. W. Toomey,** vice president, $20,000 salary, no bonus or indirect compensation, $8,795 expenses with no stock; **N. P. Blake,** vice president, $21,000 salary, $5,000 bonus and indirect compensation, $5,218 expenses and 1,323 shares of common stock.

H. H. Berke, vice president-service of supply, $28,000 salary, $14,000 bonus and indirect compensation, $3,480 expenses and 3,125 shares of common stock; **E. M. Goulard,** vice president-industrial relations, $24,000 salary, $8,000 bonus and indirect compensation, $8,245 expenses and 750 shares of common stock; **R. S. Mitchell** vice president, Guided Missiles Range Division, $29,000 salary, $12,000 bonus and indirect compensation, $11,929 expenses and 2,172 shares of common stock; **R. S. Mitchell,** vice presiurer, $30,000 salary, $15,000 bonus and indirect compensation, $4,298 expenses and 5,574 shares of common stock.

J. S. Woodbridge, comptroller, $30,000 salary, $15,000 bonus and indirect compensation, $1,721 expenses, and 1,750 shares of common stock; **H. P. Morris,** secretary and general attorney, $15,000 salary, $4,500 bonus and indirect compensation, $129 expenses, 2,875 shares of common stock and 473 shares of common stock in name of others; **S. B. Kauffman,** assistant vice president-engineering, $23,000 salary, $9,000 bonus and indirect compensation, $4,665 expenses and 750 shares of common stock; **W. W. Lynch,** assistant vice president, $30,000 salary, $6,000 bonus and indirect compensation, $4,750 expenses, 2,387 shares of common stock and $15,300 worth of debt securities.

J. C. Cone, assistant vice president, $18,000 salary, $7,000 bonus and indirect compensation, $31,811 expenses and 5,439 shares of common stock; **W. J. McEvoy,** assistant vice president, $15,000 salary, $3,250 bonus and indirect compensation, $13,327 expenses and 3,658 shares of common stock; **R. E. Smith,** assistant vice president, $22,500 salary, $4,000 bonus and indirect compensation, $12,336 expenses, 506 shares of common stock and $400 worth of debt securities; **H. M. Blackwell,** assistant vice president, $17,500 salary, $2,000 bonus and indirect compensation, $1,887 expenses and 202 shares of common stock.

R. S. Hogueland, assistant vice president (entered office 9/1/59), $7,000 salary, $4,000 bonus and indirect compensation, $1,468 expenses, 500 shares of common stock and $1,800 worth of debt securities; **R. P. Monson,** assistant treasurer, $20,000 salary, $9,000 bonus and indirect compensation, $2,961 expenses and 1,159 shares of common stock; **J. E. McGuire,** assistant comptroller, $17,000 salary, $4,000 bonus and indirect compensation, $5,634 expenses and 152 shares of common stock; **E. G. Rothrock,** assistant secretary, $13,500 salary, $2,000 bonus and indirect compensation, $3,646 expenses and 48 shares of common stock in name of others; **J. J. Cantwell,** assistant secretary, $10,200 salary, $750 bonus and indirect compensation, $389 expenses and 94 shares of common stock; **J. Macy, Jr.,** assistant secretary, $14,500 salary, $2,000 bonus and indirect compensation, $161 expenses and no stock.

Following directors were not paid salaries: **H. M. Bixby** (retired 5/26/59), $2,803 bonus and indirect compensation, $1,129 expenses and 4,095 shares of common stock; **N. Chandler,** $500 bonus and indirect compensation, $1,424 expenses and 1,000 shares of common stock; **R. V. Fleming,** $1,400 bonus and indirect expenses, $262 expenses, 200 shares of common stock and $1,500 worth of debt securities; **M. Griswold,** $1,500 bonus and indirect compensation, $445 expenses, 400 shares of common stock, 126 shares of common stock in name of others and $3,800 worth of debt securities; **R. L. Hamill,** $1,700 bonus and indirect compensation, no expenses, 6,000 shares of common stock and $150,000 worth of debt securities.

R. W. Howard, $1,600 bonus and indirect compensation, no expenses, 300 shares of common stock and $2,200 worth of debt securities; **D. S. Ingalls,** $900 bonus and indirect compensation, $993 expenses, 3,044 shares of common stock and $21,800 worth of debt securities; **R. Lehman,** $3,517 bonus and indirect compensation, no expenses, 600 shares of common stock, 4,400 shares of common stock in name of others and $35,800 worth of debt securities; **E. O. McDonnell** (deceased 1/6/60), $5,000 bonus and indirect compensation, $2,241 expenses and 1,000 shares of common stock in name of others; **M. T. McKee,** $5,000 bonus and indirect compensation, $6,269 expenses and 200 shares of common stock; **J. S. Rockefeller,** $900 bonus and indirect compensation, no expenses and 200 shares of common stock; **V. F. Taylor,** no bonus or indirect compensation, $2,745 expenses, 2,000 shares of common stock and 1,500 shares of comon stock in name of others.

Following firms were paid for services rendered during 1959: **Paul Aiken,** airmail traffic, $14,400; **Athearn, Chandler & Hoffman,** legal, $6,347; **Barnee Breeskin Enterprises,** public relations, $19,333; **Edward Larrabee Barnes Associates,** architects-design and development, $39,845; **Bechtel Corp.,** consultants, $69,172; **Eugene P. Beitler,** advertising, $50,430; **Casanova Associates,** advertising, $31,136; **Jo Chapman,** public relations, $6,941; **Cleary, Gottlieb, Steen & Hamilton,** legal, $191,961.

John Clemenger, Pty., Ltd., sales promotion, $5,200; **Coleman Productions,** sales promtion, $49,509; **Community Chest,** contributions, $25,405; **Consultores Economicos, S. A.,** public relations, $10,000; **Lee W. Court Associates,** advertising, $8,775; **Cresap, McCormick & Paget,** consultant, $7,772; **George Daly Associates,** public relations, $6,276; **Dickie-Raymond, Inc.,** sales promotion and advertising, $21,600; **Maurice Danand-Marten,** foreign exchange, $8,086; **Firestone Plantation Co.,** Medical service, $5,666; **Gardiner, Morrison, Rogers & McGuire,** legal, $6,000; **Georgeson & Co.,** solicitor of proxies, $22,576; **Jack Gourlay,** education, $8,890.

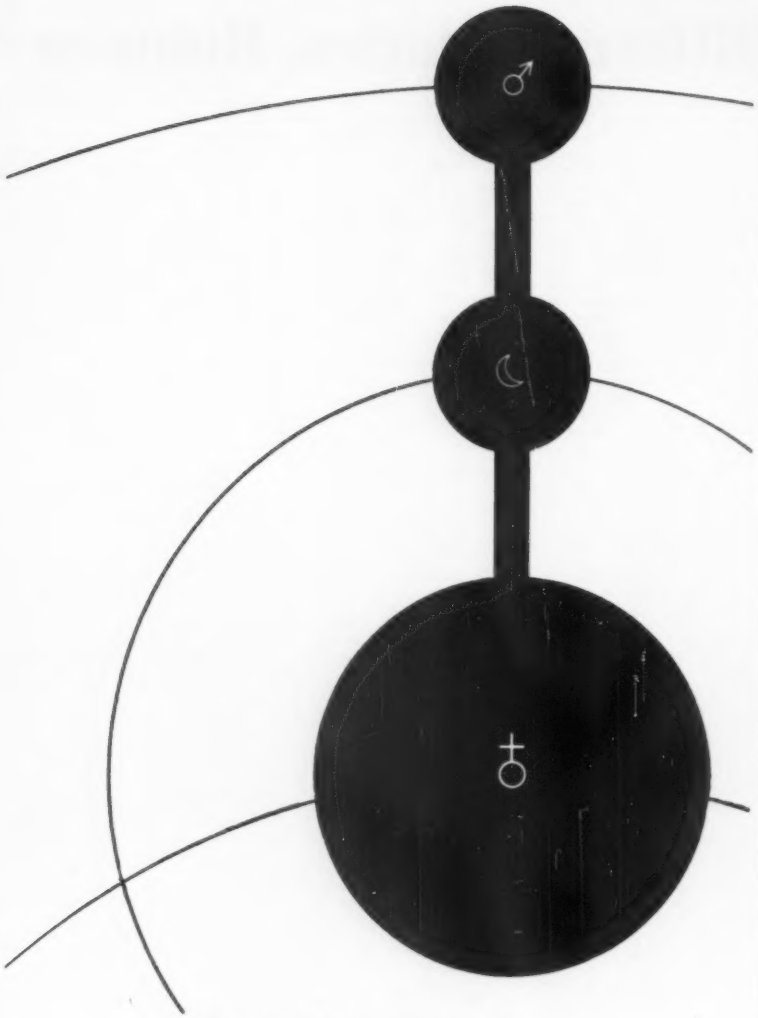
Graham, Green & Dunn, legal, $5,026; David E. Grant, legal, $5,000; **Grant & Herrmann,** legal, $5,850; **F. E. Guandique,** legal $14,422; **Escritorio Guruceaga,** consultant, $9,069; **John W. Hanes,** financial, $5,000; **Harvey Hancock,** public relations, $9,900; **William H. Holland Associates,** public relations, $10,000; **Clayton Irwin,** public relations, $22,223; **Immell, Herro, Buehner & DeWitt,** legal $24,826; **F. D. Kahlenberg,** advertising, $21,597; **Julius Klein,** public relations, $51,305; **George Kohn,** public relations, $7,150.

The Lawrence Organization, public relations, $12,663; **Robert Lee,** medical, $5,340; **Lexwood Service,** public relations, $30,727; **The Liberia Co.,** representation, $6,000; **Lybrand, Ross Bros. & Montgomery,** auditing, $154,888; **Lowell A. Mayberry,** labor relations, $67,257; **Manuel Soto Marroquin,** legal, $7,678; **J. E. McDonnell Associates,** advertising, $30,971; **Juan Arce Medina,** legal, $7,153; **Miles & Stockbridge,** legal, $17,500; **Arthur Murray, Inc.,** advertising, $30,000; **National Fund for Medical Education,** contribution, $5,000; **G. Batchelder Ollinger,** consulting engineer, $21,064.

Dr. Carlos Parraga y Garcia Hernandez, legal, $7,939; **Publicite Pan American, S.A.,** public relations, $12,033; **Rader and Associates,** engineering, $5,489; **Ross, Selnk & Carrascho,** legal, $5,222; **Kimball Sanborn,** mail consultant, $20,215; **Sanderson & Porter,** engineering, $24,352; **San Francisco Examiner,** public relations, $7,450; **Selvage & Lee, Inc.,** public relations, $24,463; **Laura B. Sheridan Associates,** public relations, $6,601; **Skadden, Arps, Slate & Timbers,** legal, $33,319; **Smathers, Thompson & Dyer,** legal, $25,780; **Stanford Research Institute,** research survey, $54,491.

Steptoe & Johnson, legal, $51,514; **Sidney J. Stiber Productions, Inc.,** public relations, $6,976; **Sullivan & Cromwell,** legal $75,588; **Ed Sullivan Radio and Television Productions,** advertising, $72,000; **United Research,** consultants, $45,423; **Columbia University,** contribution, $5,000; **Cornell University,** contribution, $5,000; **Harvard University,** contribution, $5,000; **Johns Hopkins University,** contribution, $5,000; **Massachusetts Institute of Technology,** contribution, $5,000; **Princeton University,** contribution, $5,000; **Stanford University,** contribution, $5,000; **Yale University,** contribution, $5,000; **Arthur Wollach & Associates, Inc.,** sales promotion, $5,556.

Underwriters of the company's 4¾ convertable subordinated debentures, $640,643.



SYMBOLS IN THE SKY

The Moon (☾) ... Mars (♂) ... and other planets are getting closer to our doorstep (♁). A great American team ... the huge complex of industry, science, military and civilian workers, are building the vehicles which will soon make the planets our next door neighbors. **California General** ... fabricators of assemblies for rockets and missiles ... is a significant part of this team. California General salutes this industrial and scientific complex ... and its contribution to the conquest of space ... the 20th century miracle.

CALIFORNIA GENERAL, INC.

P.O. Box 565, Dept. A, Chula Vista, California

AMF

American Airlines, Inc., (carrier did not list bonuses and indirect compensations or expenses)—**C. R. Smith**, president and director, $83,400 salary and 25,000 shares of common stock; **W. J. Hogan**, executive vice president—finance and planning and director, $68,683 salary and 500 shares of common stock in name of others; **O. M. Mosier**, executive vice president—industry planning and director, $68,683 salary and 3,000 shares of common stock; **G. A. Spater** (entered office 5/20/59), executive vice president and general counsel, $38,333 salary and 500 shares of common stock; **C. W. Jacob**, senior vice president—public affairs and secretary, $63,777 salary and 4,000 shares of common stock.

G. M. Sadler, vice president and general manager, $20,988 salary and no stock; **M. A. Brenner**, vice president (entered office 5/20/59), $20,823 salary and 155 shares of common stock; **S. C. Dunlap**, vice president, $26,064 salary and 1,000 shares of common stock; **R. L. Fitzpatrick**, vice president, $28,028 salary and no stock; **L. E. Glasgow**, vice president and controller, $40,782 salary, 600 shares of common stock, and three shares of common stock in name of others; **R. A. Goebee**, vice president, $25,228 salary and no stock; **P. W. Kayser**, vice president, $42,317 salary and 400 shares of common stock; **M. D. Kochman**, (entered office 2/16/59), vice president $30,625 salary and no stock.

W. Littlewood, vice president, $34,341 salary and 1,980 shares of common stock; **F. J. Mullins**, vice president (entered office 11/18/59), $22,322 salary and 400 shares of common stock; **W. Player**, vice president, $39,247 salary and 400 shares of common stock; **N. L. Smith**, vice president, $29,436 salary and 10 shares of common stock; **C. R. Speers**, $52,173 salary, 3,200 shares of common stock and 1,375 shares of common stock in name of others; **C. H. Startup**, vice president, $21,194 salary and no stock; **D. D. Taylor**, vice president, $22,986 salary and no stock; **E. C. Taylor**, vice president, $34,341 salary and 100 shares of common stock; **W. B. Whitacre**, vice president (assumed office 9/16/59), $28,189 salary and no stock; **F. C. Wiser**, vice president, $32,681 salary and 350 shares of common stock.

P. G. Larrie, treasurer, $23,548 salary and no stock; **M. G. Beard**, assistant vice president, $24,194 salary and 2,500 shares of common stock; **W. W. Braznell**, assistant vice president (entered office 9/16/59), $31,382 salary and 2,000 shares of common stock in name of others; **A. D. Pasquale**, assistant vice president (entered office 9/16/59), $25,272 salary and no stock; **J. V. Dooley**, assistant vice president, $22,614 salary and no stock; **W. B. Hickman**, assistant vice president, $23,421 salary and no stock; **T. F. Holden**, assistant vice president, $19,228 salary and no stock; **J. D. Hungerford**, assistant vice president, $24,035 salary and 550 shares of common stock; **J. K. Killear**, assistant vice president and assistant treasurer (entered office 11/18/59), $17,391 salary and no stock.

R. F. Lambert, assistant vice president (entered office 2/1/59), $16,861 salary and 300 shares of common stock; **W. C. Lawrence**, assistant vice president, $26,228 salary and 680 shares of common stock; **V. J. Long**, assistant vice president, $22,614 salary and 200 shares of common stock; **A. J. Moccia**, assistant vice president and assistant treasurer (entered office 2/21/59), $23,360 salary and no stock; **D. F. O'Donoghue**, assistant vice president, $27,500 salary and no stock; **C. N. Oursler**, assistant vice president, $29,114 salary and 200 shares of common stock; **W. F. Prigge**, assistant vice president (entered office 11/18/59), $17,819 salary and 150 shares of common stock.

N. D. Reynolds, assistant vice president, $25,000 salary and 100 shares of common stock; **M. W. Shipley**, assistant vice president, $23,228 salary and 400 shares of common stock; **A. E. Smick**, assistant vice president, $23,000 salary and 40 shares of common stock; **W. B. Whitney**, assistant vice president, $24,614 salary and 416 shares of common stock; **R. B. Wyland**, assistant vice president (entered office 9/16/59), $20,218 salary and no stock; **W. J. Corbett**, assistant controller, $19,421 salary and 100 shares of common stock in

name of others; **J. T. Slavin**, assistant treasurer and assistant secretary (entered office 11/18/59), $8,826 salary and no stock.

A. A. Paradis, assistant secretary, $18,114 salary and no stock; **A. R. Bone, Jr.**, regional vice president, $34,035 salary and 2,000 shares of common stock; **W. N. Bump**, regional vice president, $34,035 salary and 800 shares of common stock; **S. G. King**, regional vice president, $29,035 salary and 2,000 shares of common stock; **H. J. Lyall, Jr.**, regional vice president, $24,035 salary and 600 shares of common stock.

Following directors were not paid a salary: **H. T. Ames**, 3,500 shares of common stock and 2,000 shares of common stock in name of others; **J. W. Aston**, 500 shares of common stock; **H. E. Benedict**, 2,000 shares of common stock; **J. Bruce**, 1,100 shares of common stock; **C. L. Burgess**, no stock; **F. H. Burr**, 100 shares of common stock; **W. W. Candy, Jr.**, 200 shares of common stock; **A. G. Carter, Jr.**, 9,400 shares of common stock; **C. S. Cheston**, 400 shares of common stock; **W. L. Cisler**, 200 shares of common stock; **T. M. Conroy**, 1,000 shares of common stock; **R. S. Euler**, 2,700 shares of common stock; **M. Fleischmann**, 100 shares of common stock; **E. B. Herzog**, 1,000 shares of common stock; **J. A. Jackson**, 500 shares of common stock; **R. W. Miller**, 1,000 shares of stock; **E. M. Queeney**, 13,000 shares of common stock.

Following firms were paid for services rendered during 1959: **Alvord and Alvord**, legal, $6,026; **Berl, Potter & Anderson**, legal, $5,112; **Raymond E. Buck**, legal, $9,125; **Conn, Winters, Randolf & Ballaine**, legal, $10,978; **Covington & Burling**, legal, $337,078; **Debevoise, Plimpton & McLean**, legal, $398,572; **Evans Mershon Sawyer, Johnston & Simmons**, legal, $13,052; **Gardner, Carton, Douglas, Roemer & Chilgren**, legal, $6,816; **McAfee, Grossman, Taplin, Hanning, Newcomer & Hazlett**, legal, $6,136.

Overton, Lyman & Prince, legal, $15,835; **Richards, Layton & Finger**, legal, $7,951; **Savage, Gibson, Benefield & Shelton**, legal, $9,777; **Willke, Owens, Farr, Gallagher & Walton**, legal, $32,351; **Kahn & Jacobs**, architects, $24,982; **Howard Ketchem, Inc.**, interior design, $22,689; **Laubet & Glynn**, architects, $13,507; **Naess & Murphy**, architects, $14,213; **Kenneth H. Neptune**, architect, $9,863; **Welton, Becket & Associates**, architects and engineers, $28,760; **Edward E. Saathoff**, engineering and special construction, $49,700; **John Carl Warnecke & Associates**, engineering, $150,465; **Opinion Research Corp.**, marketing research, $150,455; **Real Estate Research Corp.**, marketing research, $6,581; **Jessie J. Friedman & Associates**, public relations, $7,648.

Arthur D. Little Inc. industrial consultant, $46,848; **McKinsey & Co.**, management consultants, $256,786; **R. H. Morris & Associates**, correspondence consultants, $12,839; **Paul B. Mulligan & Co., Inc.**, management consultants $42,000; **Charles Cramer, M. D.**, medical, $5,355; **Lovelace Foundations**, medical research, $15,032; **American Institute for Research**, pilot evaluations, $13,150; **Boyden Associates, Inc.**, personnel service, $12,108; **Hoff, Canny, Bowen & Associates**, personnel service, $10,678; **E. L. Howe**, public (employe) relations, $10,378; **Poetzinger, Dechert & Kielty, Inc.**, sales personnel training program, $10,107; **Dickie Raymond, Inc.**, $18,843; **Arthur Young & Co.**, public accountants, $64,592; **Lazard Freres & Co.**, financial consultants, $70,000; **J. P. Morgan & Co., Inc.**, trustees, $28,732.

Community Chest, contribution, $33,075; **Flight Safety Foundation**, contribution, $15,000; **Greater New York Fund**, contribution, $12,275; **National Travelers Aid**, contribution, $12,825; **American National Red Cross**, contribution, $12,170; **United Fund**, contribution $28,815.

Eastern Air Lines, Inc.—E. V. Rickenbacker, chairman of the board, $50,000 salary, $1,100 bonus and indirect compensation, $5,317.66 expenses and 53,578 shares of common stock; **M. A. MacIntyre**, president and director (entered office 10/1/59), $20,000 salary, $200 bonus and indirect compensation, $585.28 expenses and no stock; **T. F. Armstrong**, executive vice president and director, $35,000 salary, $1,100 bonus and indirect compensation, $2,678.79 expenses, 7,723 shares of common stock and 1,082 shares of common stock in name of others; **S. L. Shannon**, senior vice president and director (left office 9/1/59), $20,000 salary, $700 bonus and indirect compensation, $1,615.18 expenses and 5,747 shares of common stock; **T. E. Creighton**, treasurer and director, $17,500 salary, $1,000 bonus and indirect compensation, $632.33 expenses and 5,370 shares of common stock; **L. P. Arnold**, vice president, $22,500 salary, $2,606.69 expenses and 4,981 shares of common stock.

M. M. Frost, vice president, $27,500 salary, $5,555.04 expenses and 2,599 shares of common stock; **W. Van Dusen**, vice president, $25,000 salary, $3,711.13 expenses and 3,251 shares of common stock; **C. Foresch**, vice president, $20,000 salary, $2,301.81 expenses and 2,597 shares of common stock; **J. H. Brock**, vice president, $20,834 salary, $3,323.86 expenses and 2,221 shares of common stock; **R. Ramspeck**, vice president, $20,000 salary, $1,048.34 and 754 shares of common stock; **W. L. Morrisette, Jr.**, vice president, $21,667 salary, $4,393.04 expenses and 446 shares of common stock.

J. H. Halliburton, vice president, $25,625 salary, $1,280.88 expenses and 686 shares of common stock; **B. T. Dykes**, vice president, $29,600 salary, $672.69 expenses and 918 shares of common stock; **A. L. Chabot**, vice president, $20,834 salary, $4,822.12 expenses and 1,041 shares of common stock; **G. A. Smith**, second vice president, $20,834 salary, $2,705.13 expenses and 3,266 shares of common stock; **R. S. Lipp**, secretary, $11,000 salary, $1,055.72 expenses and 495 shares of common stock; **P. L. Foster**, assistant vice president (entered office 7/24/59), $10,659.38 salary, $277.40 expenses and 199 shares of common stock; **M. Lethbridge**, assistant vice president, $15,000 salary, $1,209.42 expenses and 542 shares of common stock.

M. B. Westphal, assistant vice president, $16,200 salary, $2,721.70 expenses and 155 shares of common stock; **F. Sharpe**, assistant vice president, $16,200 salary, $1,942.20 expenses and 815 shares of common stock; **D. C. McRae**, assistant vice president, $14,200 salary, $1,056 expenses and 727 shares of common stock; **F. E. Williams**, assistant vice president, $11,400 salary, $2,628.59 expenses and 370 shares of common stock; **M. O. Byrd**, assistant vice president, $12,400 salary, $2,549.79 expenses and 54 shares of common stock; **G. Hall**, assistant vice president (left office 4/30/59), $3,555.58 salary, $1,537.44 expenses and one share of common stock; **E. L. Williams**, assistant vice president, $11,000 salary, $5,226.91 expenses and 218 common shares.

D. L. Sinkler, assistant vice president, $12,200 salary, $3,609.25 expenses and 558 shares of common stock; **H. W. Cutshall**, assistant vice president, $11,025 salary, $3,745.66 expenses and 212 shares of common stock; **J. T. Hoffman, Jr.**, (entered office 7/24/59), $4,485.88 salary, $1,104.85 expenses and 115 shares of common stock; **A. F. Tirrell**, assistant vice president, $11,000 salary, $2,974.50 expenses and 191 shares of common stock; **J. E. Reinke**, assistant vice president, $14,000 salary, $4,127.61 expenses and 101 shares of common stock.

H. C. Dobbs, assistant vice president, $12,000 salary, $1,817.10 expenses and 289 shares of common stock; **R. E. Baskind**, assistant vice president, $12,600 salary, $2,745.24 expenses and 168 shares of common stock; **F. A. Bennett**, assistant vice president, $10,000 salary, $789.80 expenses and 224 shares of common stock; **G. W. Channell**, assistant vice president, $13,875 salary, $1,870.27 expenses and 51 shares of common stock; **C. A. Glover**, assistant vice president (entered office 5/16/59), $9,375 salary, $2,565.94 expenses and 240 shares of common stock; **B. Griffith**, assistant vice president, $8,400 salary, $1,943.55 expenses and 500 shares of common stock; **J. A. Hamill**, assistant vice president, $9,300 salary, $838.29 expenses and 240 shares of common stock.

H. Knapp, assistant vice president, $12,000 salary, $1,687.98 expenses and 348 shares of common stock; **W. T. Raymond**, assistant vice president, $15,000 salary, $14,184.52 expenses and 274 shares of common stock; **T. A. Sundem**, assistant vice president, $11,800 salary, $3,325.97 expenses and 31 shares of common stock; **E. E. Hahn**, assistant treasurer, $11,800 salary, $1,241.43 expenses and 174 shares of common stock; **C. J. Simmons**, assistant treasurer, $11,500 salary, $2,310.79 expenses, 329 shares of common stock and 56 shares of common stock in name of others; **J. C. Warlick**, assistant secretary, $10,000 salary, $1,027.13 expenses and 512 shares of common stock; **C. A. Wallen**, assistant secretary, $11,000

Lockheed Builds Mach 5 Wind Tunnel

Lockheed's California Division supersonic tunnel, built to evaluate missile and aircraft shapes at speeds up to 3,800 mph., will get its initial operating checks in July. Tunnel will employ a "blow-down" technique, using stored air for its wind supply. Temperatures during a supersonic test will drop to as low as —300F.

PRECISE ALTITUDE CONTROL

IN A 4-INCH PACKAGE

The new Daystrom Barometric Altitude Controller has unusually high frequency response to precisely position and maintain an aircraft or target drone at a constant barometric altitude—from below sea level to 125,000 feet. This 2¾ lb. unit is small enough to fit in the palm of your hand*...yet it has laboratory sensitivity that is better than 0.00036 psi! And simplified circuitry helps assure at least 1000 hours of reliable, maintenance-free operation.

At the heart of this instrument is Daystrom's unique null-balance pressure transducer. It provides unusual accuracy, simplicity and economy for a variety of airborne applications... another example of Daystrom's ability to create better instruments and systems in smaller, more economical packages for military and commercial use.

For complete information, contact your Pacific Division representative or write us for Data File AW-887-1.

*Dimensions:
2.75" high
4.00" wide
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Openings exist for qualified engineers

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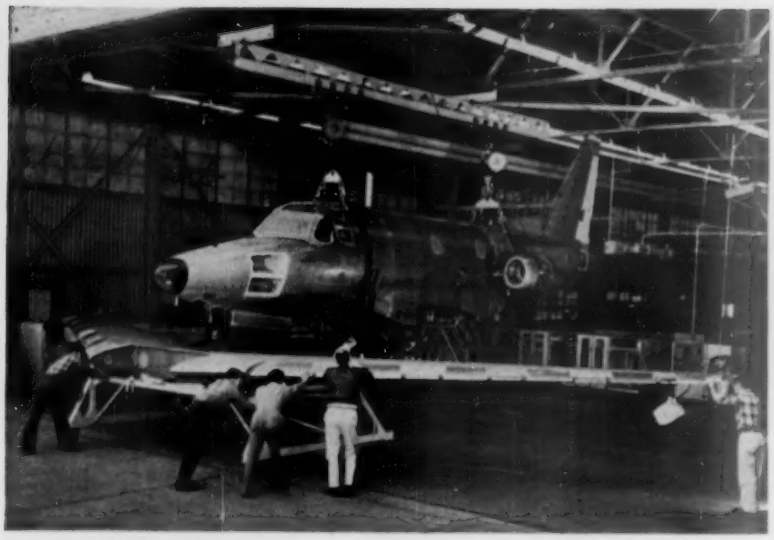

Wing Mated to First Production T-39

First production North American T-39 Sabreliner fuselage is mated with wing section at North American's Los Angeles Division. Aircraft is the first of 42 twin-jet utility trainers ordered by U. S. Air Force. Powerplants are two Pratt & Whitney J60 turbojets.

salary, $1,030.62 expenses and 300 shares of common stock.

Following directors were paid director's fees but no salary or expenses: **P. H. Brattain** (left as director 3/1/59), $12,100 fee (includes $12,000 paid under advisory contract), and 17,657 shares of common stock; **E. R. Cook**, $400 fee and 595 shares of common stock; **C. E. Daniel**, $600 fee and 1,010 shares of common stock; **P. M. Davis**, $800 fee and 3,031 shares of common stock; **J. A. Elkins, Jr.**, (entered as director 6/26/59), $200 fee and 306 shares of common stock; **G. B. Howell**, $300 fee and 1,624 shares of common stock; **H. Knowlton**, $500 fee and 524 shares of common stock in name of others; **S. Peabody, Jr.**, $800 fee and 322 shares of common stock; **P. E. Reinhold**, $900 fee, 1,625 shares of common stock and 6,282 shares of common stock in name of others; **L. S. Rockefeller**, $1,000 fee, 91,800 shares of common stock and 3,760 shares of common stock in name of others; **M. G. Smith**, $900 fee and 542 shares of common stock; **F. J. Turner**, $600 fee and 319 shares of common stock.

Following firms were paid for services rendered during 1959: **Gambrell, Harlan, Russell, Moye and Richardson**, legal, $216,046; **G. Moon**, consulting services, $6,338; **Price Waterhouse & Co.**, auditing, $35,554; **Wyatt, Grafton & Grafton**, legal, $20,998; **Gus W. Campbell & Associates**, consulting services, $9,259; **Cyrus S. Ching Associates**, consulting services, $6,122.

Delta Air Lines, Inc., (carrier did not list bonus or indirect compensation)—**C. E. Woolman**, president, general manager and director, $67,583 salary, $2,215 expenses and 41,196 shares of common stock; **T. G. Cole**, executive vice president—administration, assistant secretary and director, $40,300 salary, $1,294 expenses and 841 shares of common stock; **C. H. Dolson**, executive vice president—operations and director, $40,300 salary, $900 expenses, 1,625 shares of common stock and 187 shares of common stock in name of others; **L. C. Parker** (deceased 12/23/59), senior vice president, assistant to the president and director, $40,300 salary, $1,191 expenses and 1,875 shares of common stock; **R. S. Maurer**, vice president—legal and company director, $25,200 salary, $2,719 for expenses and 103 shares of common stock.

W. T. Beebe, vice president—personnel, $25,108 salary, $66 expenses and 187 shares of common stock; **E. Ocke, Jr.**, vice president—civic affairs, $19,987 salary, $3,455 expenses, 1,700 shares of common stock and 51 shares of common stock in name of others; **T. M. Miller**, vice president—traffic and sales administration, $24,320 salary, $2,301 expenses and 55 shares of common stock; **R. L. Griffith**, vice president, $20,802 salary, $3,429 expenses and 100 shares of common stock; **R. Oppenlander**, comptroller, $20,641 salary, $263 expenses and no stock; **R. H. Wharton**, assistant vice president—personnel, $16,268 in salary, $401 for expenses and 250 shares of common stock holdings.

C. H. McHenry, secretary, treasurer and director, $1,360 salary, $114 expenses and 1,875 shares of common stock; **C. Fitzgerald**, assistant treasurer, $7,700 salary, no expenses and 4,225 shares of common stock; **H. H. Saxon**, assistant treasurer, $12,667 salary, $342 expenses and no stock; **J. R. Howell**, assistant treasurer, $12,667 salary, $131 expenses and no stock; **C. B. Wilder**, assistant vice president—operations—technical, $19,102 salary, $104 expenses and 150 shares of common stock; **P. W. Pate**, assistant vice president—properties, $14,082 salary, $3,382 expenses and 100 shares of common stock; **C. P. Knecht**, assistant vice president-sales, $15,201 salary, $578 expenses and 272 shares of common stock; **R. W. Freeman**, chairman of the board, $1,360 salary, $6,000 expenses and 8,050 shares of common stock.

Following directors were not paid a salary: **R. W. Courts**, no expenses and 100 shares of common stock; **E. W. Gerry**, $50 expenses and 1,175 shares of common stock; **J. R. Longmire**, $353 expenses, 2,500 shares of common stock and 2,109 shares of common stock in name of others; **W. Nunally**, no expenses and 13,000 shares of common stock; **C. Putnam**, no expenses and 7,500 shares of common stock in name of others; **E. Flinn**, no expenses and 100 shares of common stock; **J. W. Rodgers**, $44 expenses and 1,000 shares of common stock.

Following firms were paid for services rendered during 1959: **Arthur Anderson & Co.**, auditing and tax services, $19,929; **Alvord & Alvord**, legal fees and services, $36,462; **Chapman, Welch & O'Connell**, legal fees and services, $53,534; **Deas Link Training Service**, special and professional services, $6,295; **Evans, Mershon, Sawyer, Johnston and Simmons**, legal fees and services, $7,119; **Powell, Goldstein, Frazer and Murphy**, legal fees and services, $42,692; **Dr. Sidney Q. Janus**, Ph.D., professional services, $7,380; **Lazo and Cubas**, legal fees and services, $6,259; **S. A. Stewart**, special and professional services, $10,000; **Turner, Rogers, Winn, Scurlock and Terry**, legal fees and services, $8,054; **White and Cass**, legal fees and services, $8,702.

...certain.

MAJOR MERGER IN SWITCH INDUSTRY

Controls Company of America Merges Hetherington Div. With Electrosnap Corp. to form New Control Switch Division.

One of the precision switch industry's most complete product lines has come into existence with the announcement by Louis Putze, President of Controls Company of America, Schiller Park, Ill., that its subsidiary Hetherington, Inc., has been merged with Electrosnap Corporation, Chicago. The Electrosnap organization was recently merged with Controls Company of America.

"This merger is important to switch users", Mr. Putze stated because it co...

WHAT'S IN IT FOR YOU?

You may now select from the industry's most versatile and complete line of precision snap-action switches, indicator lights, push-button switches, toggle switches, Switchlites, and environment-free limit switches. You can now make broader product groupings for greater quantity discounts. With this new single source, you will now deal with just one sales engineer for all your switch needs.

Three plant locations—Folcroft, Pa., Chicago, Ill., and El Segundo, Calif.—will provide regional engineering and manufacturing facilities to speed delivery and service.

Local sales offices with factory-trained personnel have been set up to provide on-the-spot application engineering in all major markets. An expanded nation-wide distributor organization will assure you of immediate delivery from local sources.

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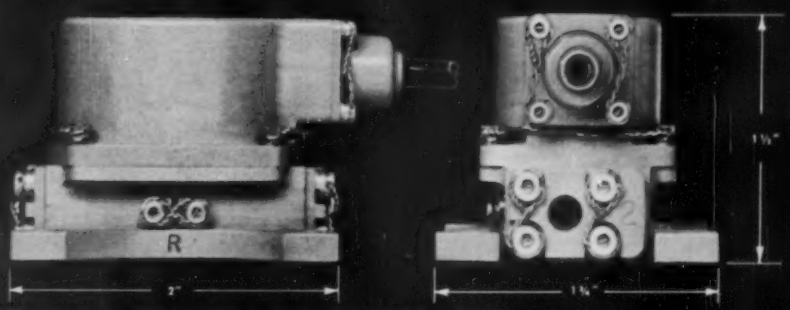

"INDUSTRY STANDARD MOUNTING DETAILS"

For critical applications where outstanding performance must be achieved with a minimum of weight, Moog offers the Series 30 Servovalve. These valves utilize the proven first stage of the standard Series 31 and 32 Moog valves, and are now available with rated flows to 7 cis at 1000 psi valve drop.

WRITE FOR PRODUCT BULLETIN 113

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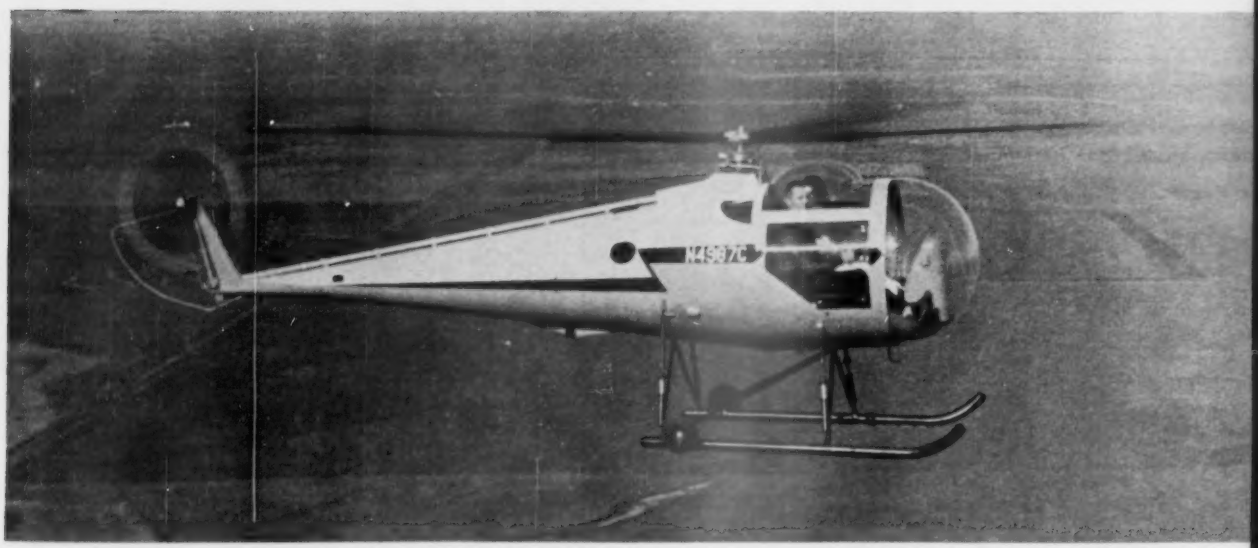
MOOG SERVOCONTROLS, INC.

PRONER AIRPORT, EAST AURORA, NEW YORK



BRANTLY B-2 helicopter has top speed of 100 mph., useful load of 620 lb., and is powered by 180 hp. Lycoming VO-360-A1A.

Aviation Week Pilot Report:

Speed, Low Vibration Mark Brantly B-2

By Robert Stanfield

New York—Brantly all-metal, two-place B-2 helicopter is a responsive and fast rotorcraft that, at a weight close to its 1,600-lb. maximum gross, cruised at an indicated 95 mph. during a flight evaluation by AVIATION WEEK.

Impressive feature, keyed to its hinged rotor blades, is the smoothness of the rotor system—particularly the absence of "wind beat." There is a lack of random vibration (something like a wheel out of balance) common to some helicopters at varying rpm. during starting, ascent and descent.

100 mph. Maximum

Top speed of the B-2, which can be achieved at about 78% of maximum continuous power, is 100 mph. Powerplant is a Lycoming VO-360-A1A of 180 hp. Operating engine speed runs from 2,700 to 2,900 rpm. Fuel grade is 91/96 octane.

The B-2, designed for private and commercial use (with agricultural equipment in the process of being manufactured) made its first flight in 1953. It was certificated in April, 1959. Basic cost is $19,950. Twenty-four were sold last year. Ten have been delivered this year. As of May 1 Brantly was in receipt of 18 firm orders from its 17 dealers, with deliveries scheduled through August.

Production schedule for 1960 calls for one helicopter a week to be produced at the Frederick, Okla., plant of

B-2 INSTRUMENTS are on pedestal. On floor below are carburetor air, mixture controls.

LIQUID HYDROGEN

. . . the ultimate rocket propellant . . . is also the world's coldest fuel.

It boils at −423°F . . . only 36.7° above absolute zero.

If air touches it, the air immediately liquefies and freezes into solid oxygen and nitrogen.

Because the latent heat of liquid hydrogen is only about 13% that of liquid oxygen, it vaporizes much more easily, and the problem of keeping it in the liquid state is severe.

The extreme demands imposed by these properties mean that techniques and equipment for handling more common cryogenic fluids, such as liquid oxygen, cannot be extended to liquid hydrogen. An entire new technology is required.

You would logically think that supplying and handling liquid hydrogen is a difficult problem. It used to be. It is no longer.

Today, Air Products is ready to supply you with liquid hydrogen and show you how it can be piped, hauled, stored and controlled with safety and efficiency comparable to that achieved with liquid oxygen.

To the special problems of handling liquid hydrogen, Air Products has brought the skill, experience and ingenuity that enabled the company to produce it by the ton for the first time. We have been producing and handling tonnage quantities for over three years.

Equipment developed and engineered by Air Products for liquid hydrogen handling systems includes vacuum-insulated transfer lines, long-distance truck trailers with capacities to 7,000 gallons, high-capacity storage tanks, centralized flow control systems, and helium systems for blanketing.

Air Products services for liquid hydrogen handling systems are complete . . . include design, engineering, manufacturing, installation and operation. These services are completely integrated to assure proper consideration of every requirement—flow rate, pressure, rate and type of usage, ambient conditions, method of delivery.

Producing and handling liquefied gases at ultra-low temperatures has been the specialized business of Air Products for over 20 years. We will welcome the opportunity to answer your questions about obtaining and handling liquid hydrogen, and to put our experience to work for you. Air Products, Inc., Allentown, Pa. Phone: EXpress 5-3311.

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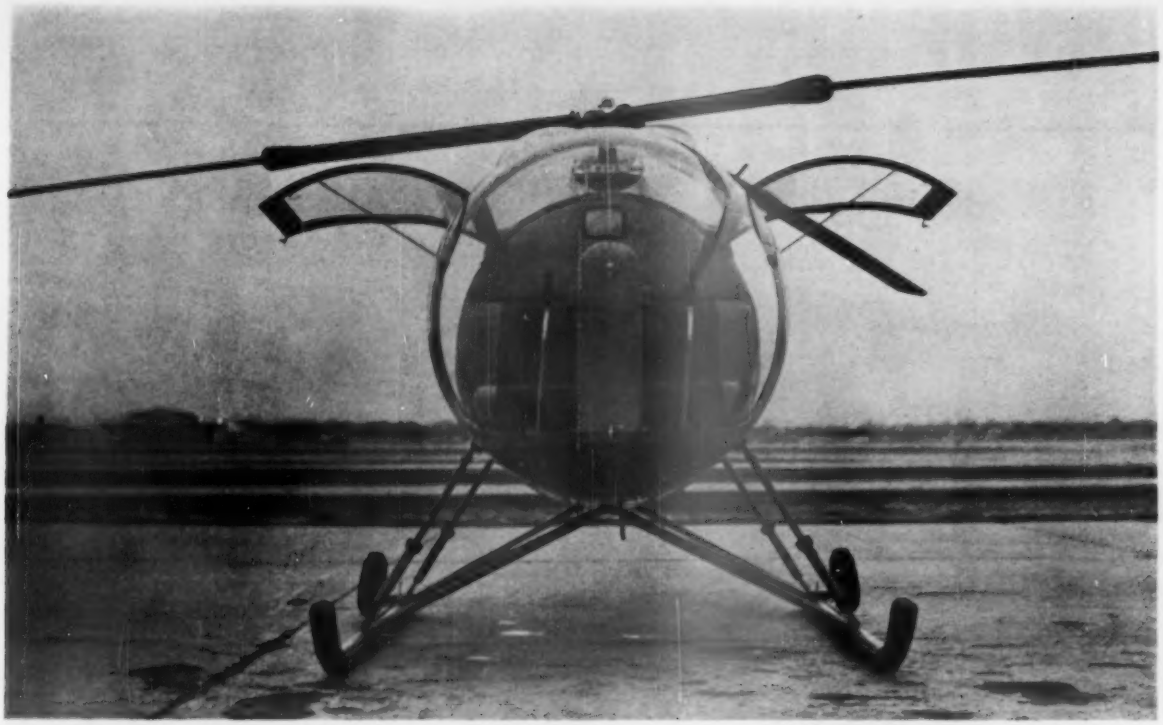


CYLINDRICAL cabin of B-2 has spherical plexiglass nose canopy and two small overhead plexiglass bubbles for more head room.

Brantly Helicopter Corp., the main offices of which are in Philadelphia, Pa. Users of the B-2 include state police, a coal mine operator, an asphalt paving company. Five rotorcraft were delivered to the U.S. Army last year for evaluation.

The B-2 is being demonstrated to the Brazilian air force.

Most recent B-2 change involved removal of the stabilizer from the tail cone, since flight tests showed it was not necessary to give a positive stick slope. Stabilizer is now an optional item. Most significant of the refinements developed between first flight and certification is its rotor with the outboard hinge—a horizontal and vertical hinge positioned at approximately 40% of the radius of each of its three blades.

The inboard blade has a symmetrical section with a 29% thickness ratio and an effective chord of 8.84 in. It is set at an angle of incidence which is 4 deg. greater than the outboard blade, which has a modified NASA 0012 section with an 8 in. chord. Inboard flapping hinge is offset a distance of 2.67 in. from the hub.

Aim is to eliminate feed-back in controls, eliminate ground resonance, hold a low level of vibration and improve rotor control in the low-speed range—making it possible to start and stop the rotor safely in high winds.

Demonstrator flown at Westchester County Airport was N6791D, Brantly serial number 10. Along with AVIATION WEEK pilot was Ricardo Olaran, president of Alta Aviacion Latino Americana, distributors of the B-2 in Bogota, Colombia, South America.

Sitting on its skids the B-2 has the appearance of a horizontal ice cream cone. It's a clean, streamlined rotorcraft, small and compact, with fuselage of stressed-skin construction. The cabin is cylindrical with a spherical plexiglass nose canopy and two overhead plexiglass bubbles, for additional headroom.

Approximate weight of the rotorcraft, complete with cabin doors and with engine and transmission oil, is 1,000 lb. For the maximum gross weight of 1,600 lb., the total of the cabin seat, fuel and baggage loads cannot exceed 600 lb. with doors installed, or 610 lb. with doors removed.

Fuselage from the cabin section aft is conical, consisting of center and tail sections. Former provides primary support for the rear landing gear fittings, main rotor and transmission, and tail section. The tail section supports the tail rotor, its drive and controls. The 6-cu.-ft. (50 lb.) baggage compartment is located in the forward end of the fuselage section, just aft of the rear firewall.

With the B-2 on skids, the two-bladed tail rotor is 20 in. from the ground, protected by a sturdy guard. Four shock absorbers of the skid gear each consist of an oleo damper in series with a synthetic rubber disk which limits travel. Gear tread is 5 ft. 8.25 in.

Doors on either side of the Brantly cockpit hinge upward. One has to duck when approaching the rotorcraft be-

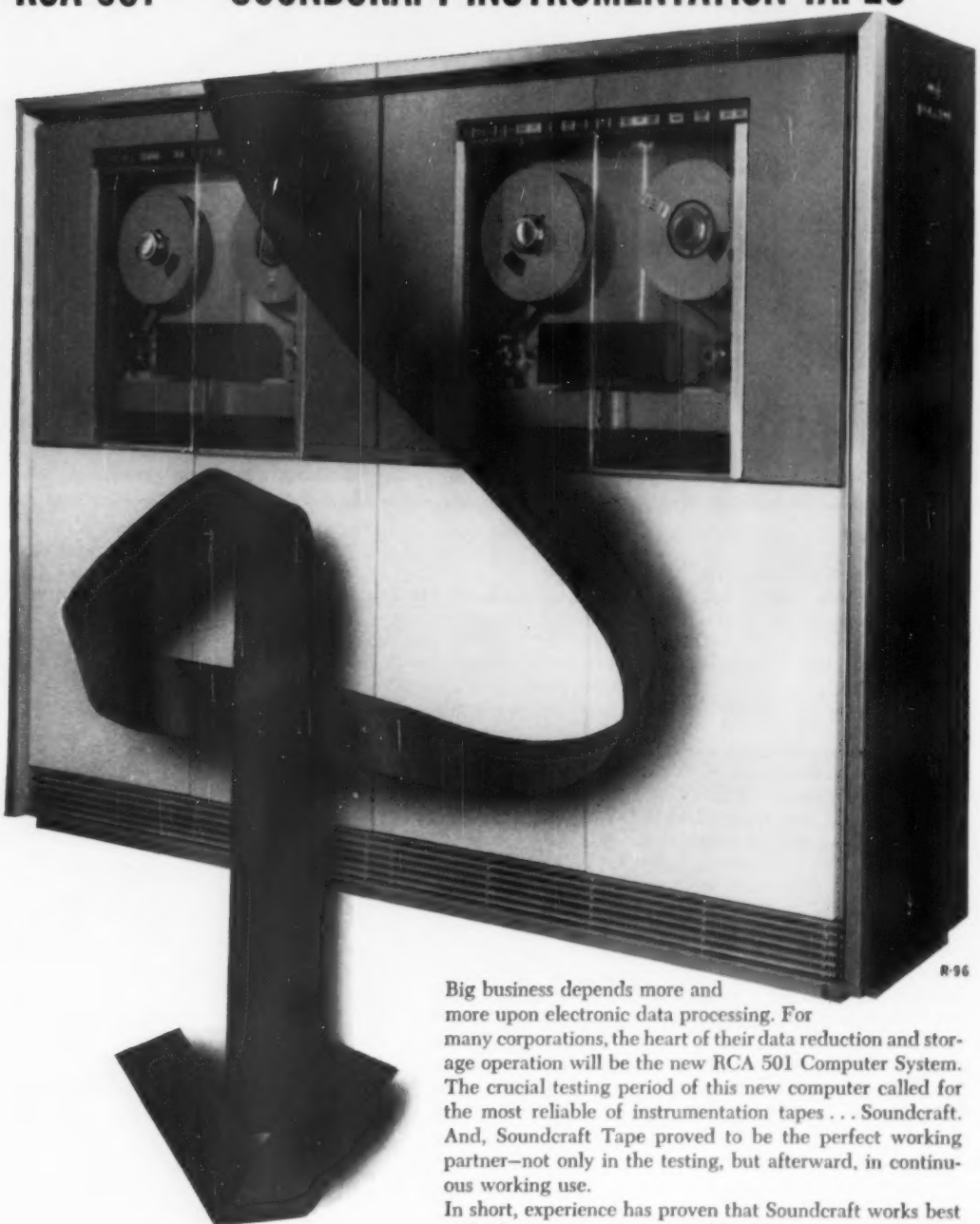
Brantly B-2 Performance

Maximum speed	100 mph.
Rate of climb (sea level)	1,580 fpm.
Endurance	3 hr.
Range	300 mi.
Fuel consumption	10 gph.
Hovering ceiling (IGE)	4,700 ft.
Service ceiling	10,400 ft.

BAGGAGE capacity is 50 lb. (6 cu. ft.). Compartment lies just aft of rear fire wall in forward end of fuselage section.

WORKING PARTNERS

RCA 501 — SOUNDCRAFT INSTRUMENTATION TAPES



R-96

Big business depends more and more upon electronic data processing. For many corporations, the heart of their data reduction and storage operation will be the new RCA 501 Computer System. The crucial testing period of this new computer called for the most reliable of instrumentation tapes . . . Soundcraft. And, Soundcraft Tape proved to be the perfect working partner—not only in the testing, but afterward, in continuous working use.

In short, experience has proven that Soundcraft works best on leading computer systems, like the RCA 501. Let precision-made, trouble-free, error-free Soundcraft Instrumentation Tapes go to work for you. *Complete literature on request.*

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BRANTLY plant at Frederick, Okla., has a production schedule of one B-2 helicopter a week during 1960. Five were delivered in 1959.

cause of the proximity of the turning blades. Seating is comfortable, though there is not an overabundance of room. Width of the cabin section is 3 ft. 11 in. Controls are dual, with the microphone button on the pilot's cyclic stick only. Navigation lights are available as optional equipment.

B-2 Instrumentation

B-2 flight and engine instruments are mounted on a centered pedestal, with Narco Superhomer VHT-3 radio just beneath. At base of the panel are starting switches and circuit breakers. Instrumentation did not include a rate-of-climb indicator; for this flight estimates were made by time-to-altitude checks. Centered between the pilots, on the floor, are levers for carburetor air and mixture control. Against the seat-front are the nose-trim switch plus indicator, the fuel shut-off and manual rotor-brake controls.

Blades already were turning when we climbed into the small rotorcraft. Powerplant limitations include idling speed of 800 to 900 rpm., plus operating speed of 2,700 to 2,900 rpm. Engine operation between 2,500 and 2,600 rpm. (critical vibration range) is to be avoided. Airspeed is redlined at 100 mph.

Field elevation at Westchester County is 441 ft. Sea level pressure at takeoff

Brantly B-2 Specifications

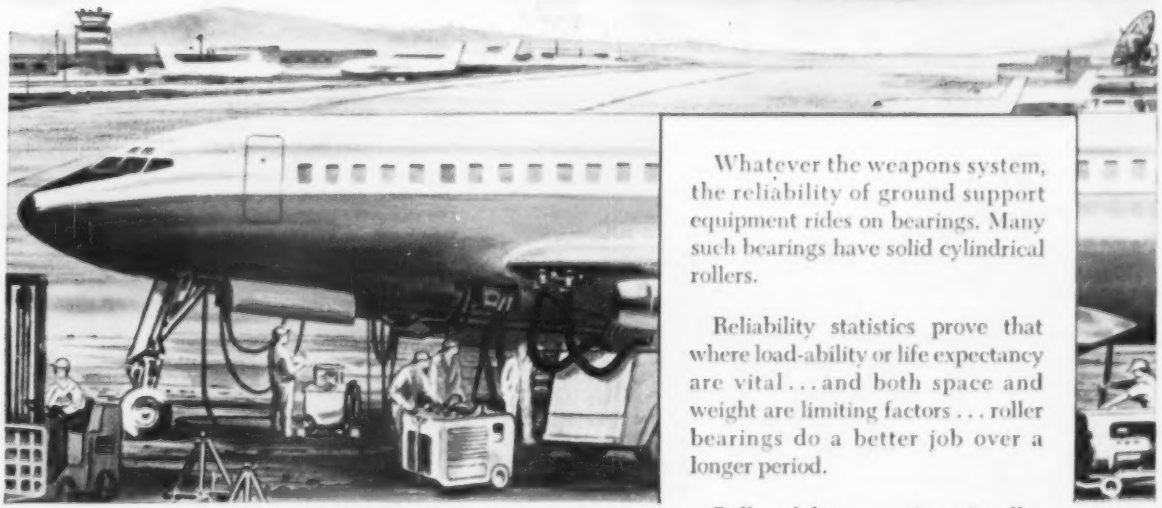
Gross weight	1,600 lb.
Empty weight	980 lb.
Useful load	620 lb.
Length over-all	21 ft. 9.1 in.
Height	6 ft. 11.75 in.
Width (cabin section)	3 ft. 11 in.
Skid gear tread	5 ft. 8.25 in.
Disk loading	3.58 psf.
Power loading	8.9 lb./hp.
Main rotor (three blades):	
Diameter	23 ft. 11.25 in.
Inboard flapping hinge offset	2.67 in.
Inboard blade chord	8.84 in.
Inboard blade incidence (low pitch)	7 deg.
Outboard flapping hinge offset	51.85 in.
Outboard blade chord	8 in.
Outboard blade section	NASA 0012
Outboard blade incidence (low pitch)	3 deg.
Tail rotor (two blades):	
Diameter	4 ft. 3 in.
Root chord	4.187 in.
Tip chord	2.703 in.
Height from ground (aircraft on skids)	20 in.
Fuel capacity	186 lb. (31 gal.)
Baggage capacity	50 lb. (6 cu. ft.)

Engine:

Lycoming VO360-A1A of 180 hp. Engine speed, 2,700-2,900 rpm. Engine to rotor ratio, 6.158 to 1; engine to tail rotor ratio, 1 to 1. Recommended overhaul period: 600 hr.

On the Ground as in the Air...

RELIABILITY rides on BEARINGS



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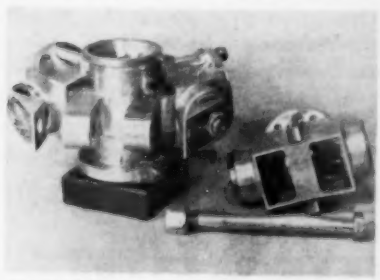
INBOARD blade has a symmetrical section with a 29% thickness ratio and an effective chord of 8.84 in. It is set at an angle of incidence which is 4 deg. greater than outboard blade.

was 30.09 in. Outside air temperature was 51F. A light wind was blowing from the northwest at 2 kt.

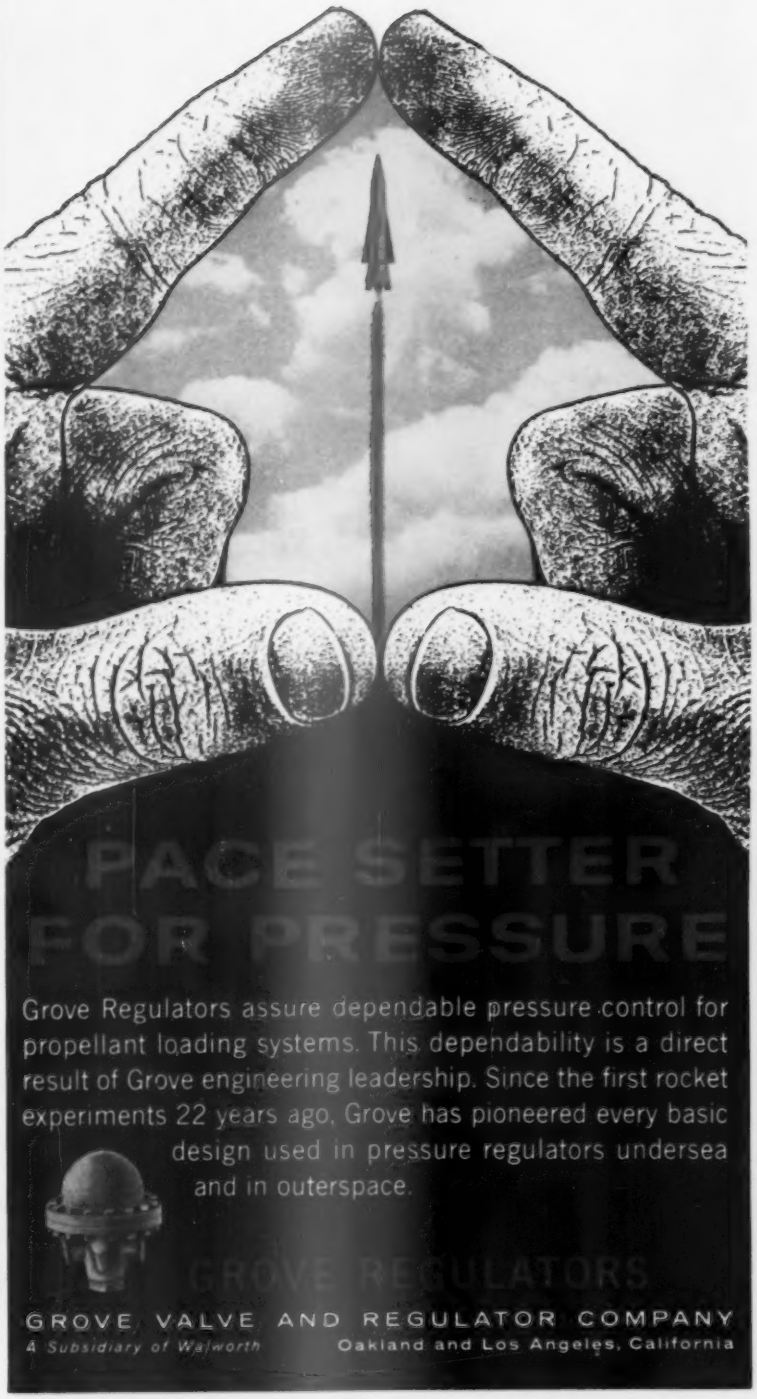
Initially the B-2 was hovered at 22 in. manifold pressure and 2,900 rpm.; fairly good power setting under these conditions. Vibration was not excessive but the noise level was somewhat to the extreme. Additional soundproofing is now worked into production aircraft, Walter L. Heppenstall, vice president, Kite Helicopter Corp. (a B-2 distributor), Ambler, Pa., told AVIATION WEEK.

Best rate of climb of the B-2 is specified as 1,100 fpm. With power advanced to 24.5 in. and 2,850 rpm., the helicopter moved forward and up at 40 mph. Speed was increased to 50 mph. at 400 ft.; to 55 mph. at 700 ft. Altitude of 900 ft. was reached in one minute.

At 1,000 ft., with power at 24.75 in. and 2,900 rpm., the B-2 indicated 95



PROPELLER hub for the main rotor is shown in photograph above, together with the inboard flapping hinges for the rotor blade.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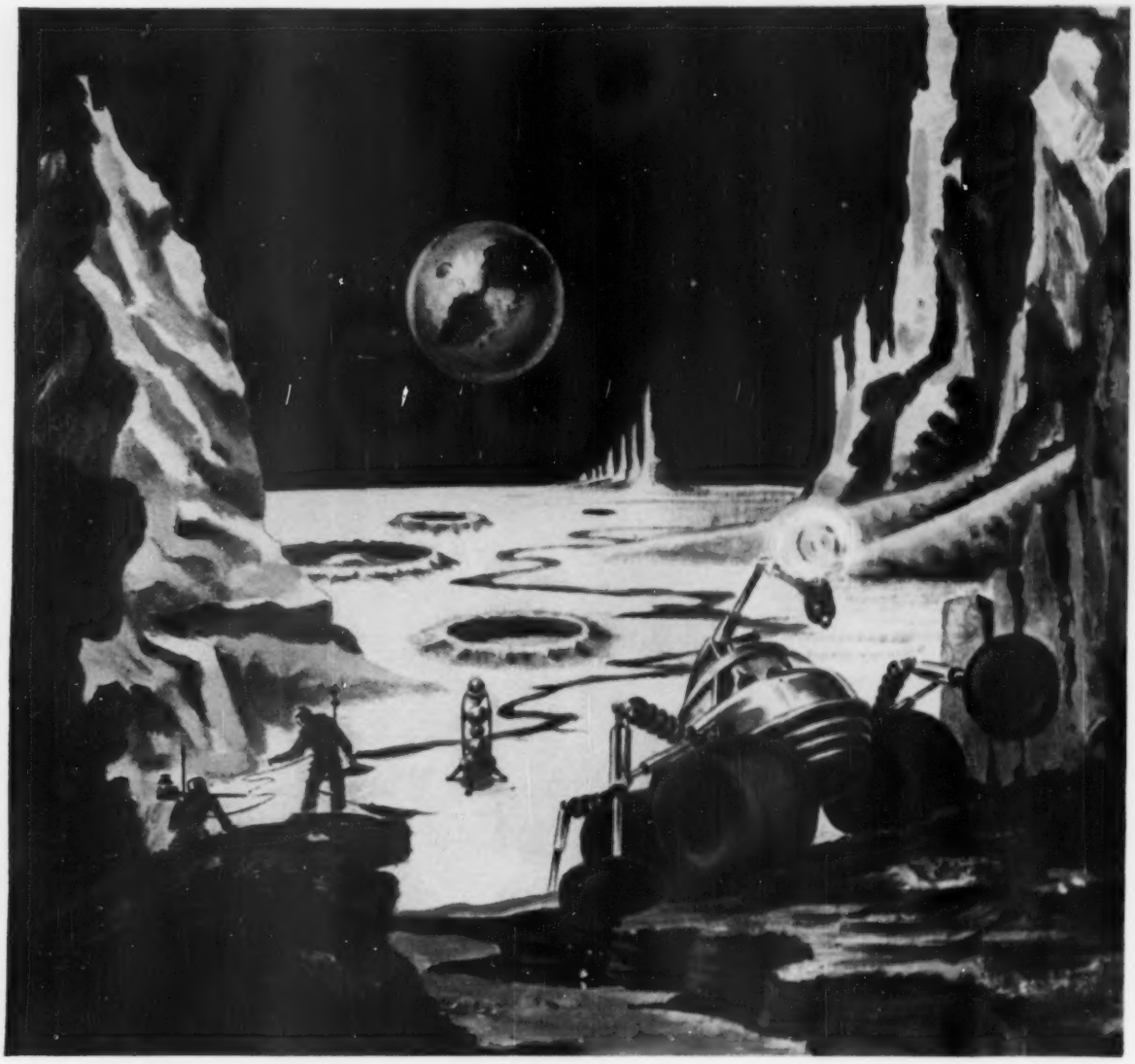

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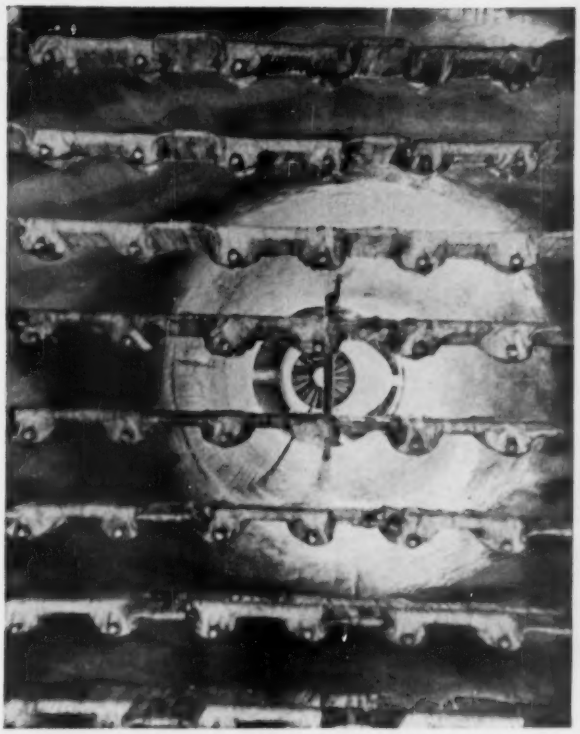


Anti-Icing System Tested on GE Aft-Fan Engine

General Electric aft-fan engine is seen 15 ft. down the tube from battery of 117 spray nozzle bars at company's outdoor anti-icing test facility near Schenectady, N. Y. Test demonstrates the effectiveness of the engine's anti-icing system. At right, a GE CJ805-23 aft-fan engine is surrounded by a 6-ft. diameter pod, through which a fan at rear draws secondary air to increase thrust. Hot air outlets in the pod provide anti-icing for concentric leading edges of the engine.

mph. From this altitude the B-2 was eased up to 1,500 ft. and hovered at 24.5 in. and 2,850 rpm. With power at 22 in. and 2,850 rpm., the rotorcraft again indicated 95 mph. at this altitude.

The B-2, with its clean configuration, picks up speed quickly. It is sensitive and quick on the controls, quite responsive both to light pressures and to power application. Its vertical climb speed is above average for its class of rotorcraft; its descent speed on a par with similar type helicopters.

Average autorotation descent speed of the B-2 runs between 60-70 mph. Best glide ratio, at 60 mph., is about 3:1. To improve present autorotation characteristics—to work into the B-2 a better rate of decay, since a light rotor will lose rpm. faster—Brantly is now installing 1.5 lb. of weight into the outboard section (from the hinge out) of each blade.

Several autorotations were made from altitudes of 1,500 to 1,800 ft., the B-2 in each instance being very responsive in pickup out of the autorotation. In one instance, following a pull-out close to the deck, Olaran held the B-2 to zero airspeed, using 20 in. and 2,850 rpm.

When the B-2 engine speed is adjusted so that the needle is near the center of the 2,700-2,900 rpm. range, the throttle and collective pitch synchronizer will maintain engine speed within the power-on limits throughout power-on flight. A landing also can be made without adjusting the throttle.

In the latter instance the engine will be running for a short period in the critical vibration range (2,500-2,600 rpm.) with the rotor still engaged. This can be avoided by "splitting the needles" after landing and allowing the rotor to disengage before the engine speed drops into the critical range.

Oleo shock absorbers reduced any bouncing tendency of the gear during landings at a slightly nose-high attitude. Each oleo damper incorporates a flapper valve to offset resistance at touchdown. This valve closes during compression of the oleo with the oil flow being governed by a metering pin. At flight termination, and during engine shut-down procedure, the rotor brake is applied after the rotor speed has decreased to less than 200 rpm.

The Brantly induction cooling system utilizes exhaust gases from the en-

Kaman HU2K with GE J85

Model of Navy's turbine-powered utility helicopter, the Kaman HU2K, shows 400-lb. jet pod mounted on the side of fuselage to provide increased speed, range, lift and versatility. Detachable pod, which encloses a General Electric J85 turbojet, could be ready for flight testing in six months.

SILICONE NEWS from Dow Corning

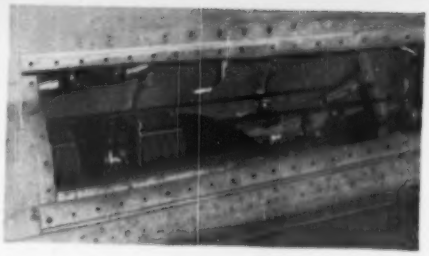
Many Parameters, One Elastomer

SILASTIC® meets varied specs in Convair F-106

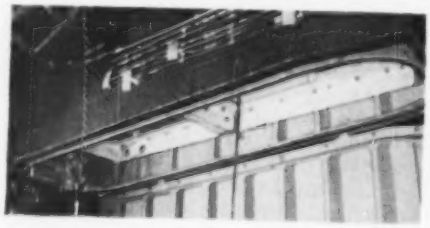
When you're calling out materials on a plane or missile, isn't it a help to have one material that can meet a variety of rubber needs? A material that's been proven in all flight regimes? Engineers at Convair San Diego, Div. of General Dynamics Corporation found it so. The material is Silastic, the Dow Corning silicone rubber, and they specify it for many applications aboard the Mach 2-plus F-106 all-weather interceptor.

A few of the uses are illustrated here. At left you see molded parts . . . plug connectors used for checking out instrumentation. Located in the aft missile bay, they are subject to high flash temperatures during rocket firings. The reliability of Silastic in this part is reported excellent, with no failure even in the presence of chemicals or exhaust gases. (Wire bundle clamps are also of Silastic.)

A completely different application of Silastic is shown at right top: one of many connectors in the air bleed system. All connectors are covered with a flexible bellows of glass-reinforced Silastic. The duct beneath carries air at 800 F, and though there is insulation between steel duct and cover, the Silastic must still tolerate high temperatures while retaining its rubberiness and sealing ability.



Among other seals of Silastic aboard the F-106 are these hollow extrusions on the air-conditioning compartment door. They withstand severe temperatures, maintain a firm air-seal after extended lengths of time under compression.



Silastic stays rubbery from —130 to over 500 F; resists aging, weathering, oxidation. Your rubber parts supplier will engineer a part made of Silastic to add reliability to your design. For name of nearest fabricator or more data, write Dept. 0905.

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First Flight of Turbine-Powered Skeeter

Skeeter helicopter is seen during first flight powered by a Blackburn Turmo Series 601 gas turbine engine. Engine normally develops 425 shp. but was derated to 250 shp. for this installation. Piston-engined Skeeter, manufactured by Saunders-Roe Helicopter Division of Westland Aircraft Ltd., is in service with British and West German armies.

gine to create a pressure drop in the exhaust manifolds or inductors which draws cooling air through passages formed by cylinder head baffles. Cooling air enters the engine compartment through air scoops located near the top of the engine compartment on each side of the fuselage. In forward flight the volume of cooling air is increased by ram effect.

Cooling for the engine oil is provided by an external Harrison type cooler aft of the engine compartment. Intermediate gear box is at the lowest point in the tail rotor drive and is a convenient oil sump for the system.

The main tail rotor shaft is hollow. It is housed in a tube extending the length of the tail section with bearing supports provided at about 18 in. intervals. It is lubricated via a fixed internal worm pump in the intermediate gear box.

Tail rotor extension shaft is also hollow. A similar stationary worm gear pumps oil from the intermediate gear box up through the shaft to the tail rotor gear, with a return passage provided by the space between the shaft and its housing. System vent is located near the top of the tail rotor gear box.

720 Demonstrates Minimum Landing Roll

Boeing 720 medium-range jet transport has been landed within 2,200 ft. over a 50-ft. obstacle at a landing weight of 135,000 lb. in the course of Federal Aviation Agency certification trials. Minimum runway landing was accomplished despite a 6 mph. tailwind.

Full-span wing leading edge flaps extend automatically in conjunction with trailing edge flaps to provide increased lift at high angles of attack, reducing ground roll by some 10%. Increased lift effect cuts landing and takeoff speeds by 7-11 mph.

The three Boeing 720s used in the

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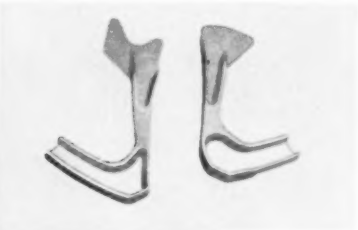

AIRSCOOP FITTINGS
Alcoa no-draft forgings with contours forged to various angles.

Take a close look at the *Dorsal Former* at left. Notice the thin, upstanding ribs. Alcoa forged this part to finished dimensions, *with no inside taper to machine off.*

Alcoa supplies Lockheed with many close-tolerance, untapered rib forgings. The *Airscoop Fittings* are sophisticated examples. In all, the F-104 carries 60 no-draft forgings. Lockheed estimates the average saving over conventional machined parts comes to 40 cents on the dollar.

Let us show you what we can do with aluminum in any form—plate, casting, forging, extrusion, impact. Call any Alcoa sales office, or write Aluminum Company of America, 2026-E Alcoa Building, Pittsburgh 19, Pa.

WINDSHIELD FRAME
We mention the *Windshield Frame* above to point out our capabilities in other directions. This part measures 38 x 30 x 6 in. Wall thickness is 0.110 in. for 80 per cent of the casting area. This requires several sand and plaster cores which have to assemble and hold dimensions within ±0.03 in. across the joints. Casting must conform to fuselage contour within 0.015 in. To top it off, defects considerably smaller than a pinhead are cause for rejection.

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LOCKHEED'S F-104 STARFIGHTER
Winner of the Collier Trophy for 1959. Currently holds world's altitude record of 103,395 feet and all eight time-to-climb records. First airplane ever to hold world's altitude, speed and time-to-climb records simultaneously.

NATO VTOL Program

Paris—NATO international staff here already has begun initial work to establish a construction program for a standard VTOL fighter to be operational within four to six years.

General operating requirements for the VTOL fighter have been drawn up by SHAPE and transmitted to NATO's aircraft production board. Considerable controversy, however, still surrounds technical and operating concepts of new program.

Manufacturers interested in the program will be officially queried shortly. Many companies currently are exchanging ideas between themselves in order to work out a common bid. British government, in particular, has been seeking out West European interest in British VTOL projects without, it seems, as much success as British reports on the subject indicate.

It seems certain that NATO's VTOL program will be a European show and that final specification will be financed, designed and built by NATO's European members. U. S. VTOL concepts, however, will seep into the program via tieups—some made and other in the works—between American and European aircraft companies. Republic Aircraft's VTOL work, for example, will get involved through Republic's recent agreement with Fokker of Holland (AW Mar. 28, p. 32).

No firm timetable has yet been laid down by NATO staff. It is generally hoped, however, that the VTOL program will be firmed up early next year.

current certification program have logged more than 240 hr. flight time, and have attained a maximum speed of Mach 0.95. A leading edge extension which increases the sweep angle of the wing between the fuselage and the inboard engines gives the 720 a boost in top speed of more than 14 mph. compared with the bigger 707s.

PRODUCTION BRIEFING

Lear, Inc., Santa Monica, Calif., will produce automatic flight control and stabilization systems for Ryan Q-2C target drones under $1.7 million follow-on contract. The flight control system, which executes radio-command signals, includes vertical and rate gyros, attitude controller, airspeed and altitude sensors, power supplies, servo amplifiers and mode-switching relay circuits.

AiResearch Mfg. Division, Phoenix, Ariz. will build additional air turbine motors for the Republic F-105 fighter-bomber under $250,000 contract.

BENDIX-PACIFIC THRUST CONTROLLER FOR ATTITUDE CONTROL OF SATELLITES

To stabilize the attitude of a space vehicle the Bendix-Pacific Cold Gas Thrust Controller has demonstrated its accurate effectiveness on the Discoverer and other Satellites.

The Controller, developed by Bendix Research Laboratories in collaboration with Bendix-Pacific, produces thrust proportional to an electrical signal by discharging compressed nitrogen through the nozzle. The Controllers are installed in pairs to stabilize each of the three axes.

The model illustrated, which weighs only 17.5 ounces, incorporates a 2-stage pressure control valve and has a maximum thrust capacity of 20 pounds. Other configurations are available.

Complete information is available on request.

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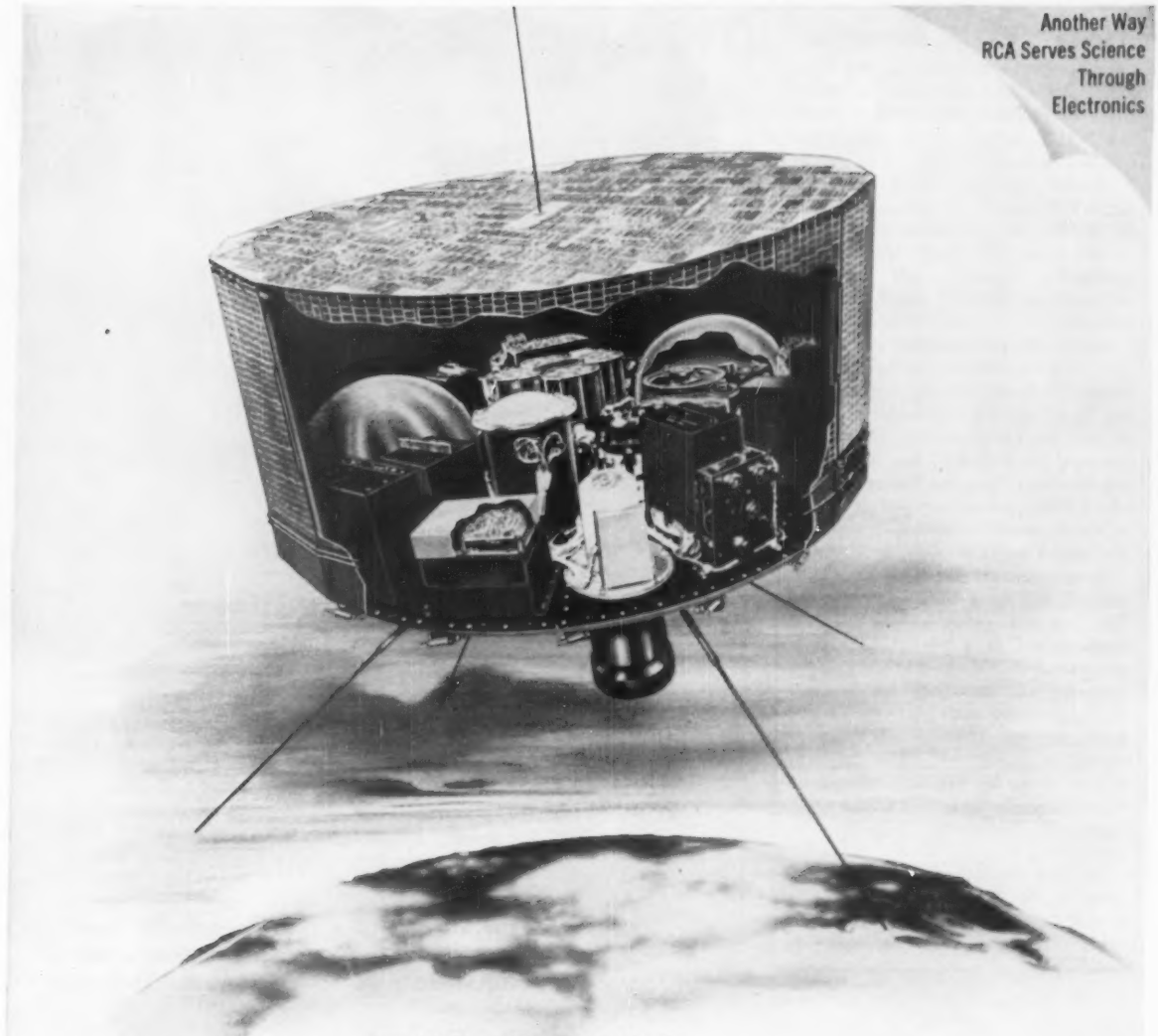

THIS IS TIROS...

Experimental Weather Observer

This is TIROS—the world's most advanced television-equipped earth satellite. In one giant step it has extended man's powers of continued observation 400 miles into space. The pictures of cloud cover and wind patterns it is now sending down are a major contribution to the science of meteorology—bringing ever closer the day of improved, long-range weather analysis and forecasting.

The entire TIROS satellite, its component systems and associated ground equipments were developed and built by RCA's Astro-Electronic Products Division for the National Aeronautic and Space Administration under the technical direction of the U. S. Army Signal Research and Development Laboratory. Included in the satellite are two TV cameras equipped with shutters so they can take still pictures, tape recorders to store the pictures when out of ground station range, TV transmitters, command receivers and timing clocks for function control, radio beacons and telemetry equipment, and numerous auxiliary devices to control satellite dynamics. Power is supplied by storage batteries recharged by an array of 9200 solar cells which convert the sun's energy into electricity.

Significant as it is, TIROS is a beginning, not an end. Future satellites and space probes will be far more complex. Yet they will grow out of the experience and capabilities in space electronics, satellite dynamics and structural loading techniques that made Project TIROS a reality. To find out how you can draw on this unique research and development capability, get in touch with the Marketing Manager, RCA Astro-Electronic Products Division, Princeton, N. J.

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House Group Asks Procurement Changes

By Katherine Johnsen

Washington—House Armed Services Committee, following a week of hearings on military contracting highlighted by sharp criticism of the incentive-type contracts widely used by Air Force and Navy, has requested the General Accounting Office to draft defense procurement legislation that would:

- **Assure maximum** use of competitive advertised bid contracts.
- **Assure maximum competition** in negotiated contracts.
- **Discourage "sole source"** procurement, particularly by requiring detailed production drawings and details from contractors so that competition can be introduced in procurements as early as possible.
- **Set standards to encourage** sound judgment in the selection of the "proper type" of contract.
- **Require that cost information,** particularly on cost-plus-fixed-fee, incentive, and price redeterminable types of contracts, be "complete, accurate, and timely."
- **Permit profit rewards** to contractors for "true efficiency, product improvements and advancement in the state of the art" in cases where savings to the government can be "concretely demonstrated" by the contractor.

The attack on incentive contracts—which appeared to be the main objective of the committee sessions—was led by Chairman Carl Vinson (D.-Ga.), who last year conducted a successful one-man campaign for a three-year "as is" extension of the Renegotiation Law and defeated an amendment that would have required the Renegotiation Board to give special consideration to cost savings by manufacturers under incentive contracts in considering excessive profits (AW July 6, p. 28). Defense Department and the aerospace industry urged the amendment on the grounds that manufacturers who save on costs under the incentive that they will be allowed to retain 20% of the saving should not be required subsequently to refund it by the Renegotiation Board. The lion's share of the excessive profit determinations of the Board has been directed at aerospace firms performing under incentive contracts.

Vinson insistently contended that, with the incentive contract, there is only the illusion of a cost saving, and that this simply indicates that the contract was over-priced in the first place.

Renegotiation Board and General Accounting Office supported Vinson's position. Under prodding, the Army also concurred.

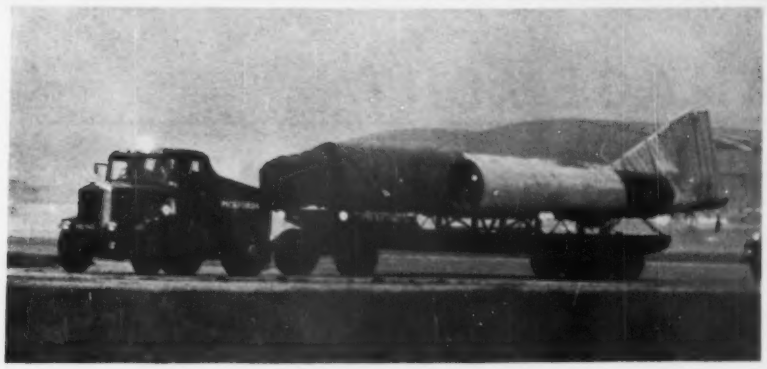
"We have examined the matter many, many times, but have never found any type of procurement in which the incentive type contract would be advantageous to the government," Courtney Johnson, assistant secretary of Army for logistics, told the committee in response to questioning. As an alternative to the incentive contract—in the procurement area between the cost-plus-fixed-fee, used generally for research and development where costs are unknown, and the fixed price contract, used where costs are well known—Army uses the price redeterminable contract in missile and other procurements. Johnson said that, in redetermining contract prices, Army gives consideration to the contractor's "efficiency, economy and ingenuity" in the allowance of profits. In Fiscal 1959, 295 Army redeterminable contracts originally priced at $656 million were subsequently repriced at $631 million, a reduction of $25 million. Profit on the contracts was reduced by $8 million.

The basic difference between the incentive and price redeterminable types is that, in the incentive type, costs and target price are estimated in advance of actual performance, and in the price redeterminable type, cost allowances are based upon the results of actual performance.

Air Force and Navy defended their

German Steel Firm Accepts Beech Queen Air

First export delivery of a Beechcraft Model 65 Queen Air executive transport was made to Rochling Iron & Steel Co., of Volklingen, Germany, at Wichita, Kan. (AW Apr. 11, p. 121). Taking delivery are Allen Pepin, left, of Travelair GmbH., Beech distributor at Bremen, and Capt. Helmut Jakobs, Rochling chief pilot. Plane is fitted with Goodrich de-icer boots, now an optional item. Capt. Jakobs flew the Queen Air to Germany via Newfoundland, the Azores and Portugal. It will replace a Beech Twin Bonanza.



Bristol Type 188 Moves to Farnborough

Bristol Type 188 stainless steel Mach 3 research aircraft (AW Jan. 25, p. 150) is moved to Farnborough for structural tests. Second airframe is being readied for first flight later this year. De Havilland Gyron Jr. DGH 10 turbojets will be flight tested later this month in a Gloster Javelin. The Type 188 also may be used as a ramjet testbed.

use of incentive contracts but conceded that undeserved profits "could" be made by contractors.

Qualifying that there must be a "valid target" price, Philip B. Taylor, assistant USAF secretary for materiel, said:

"We have urged an increase in the use of this type of contract in appropriate circumstances as one of the more fundamental means of creating an incentive to contractors to reduce costs."

Maj. Gen. W. A. Davis, director of procurement and production for the Air Materiel Command, subsequently told the committee that USAF's use of incentive contracts "has steadily declined" —from 31% of the dollar volume of procurement in 1956 to 26% in 1959.

Fred A. Bantz, undersecretary of Navy, testified that the incentive contract is "vital to the interests of the Navy Department in order to procure complex equipment at the least cost. We feel strongly that, if this type of contract were not available, we would be forced into greater use of redeterminable and cost-type contracts which, in our opinion, are not as effective in controlling costs."

Thomas Coggeshall, chairman of Renegotiation Board, explained the weaknesses of the incentive contract to the committee:

"In the incentive contract, the incentive formula operates automatically whenever costs are less than estimated and without reference to the reasons. . . . It is obvious, then, that for reasons wholly unrelated to the contractor's efficiency the contract may yield greater profits than could reasonably have been foreseen. Such profits may be due to erroneous estimates of target costs; they may also arise from unanticipated cost savings attributable to the impact of additional defense production volume, from lowered market prices of materials, or from other extrinsic causes. . . .

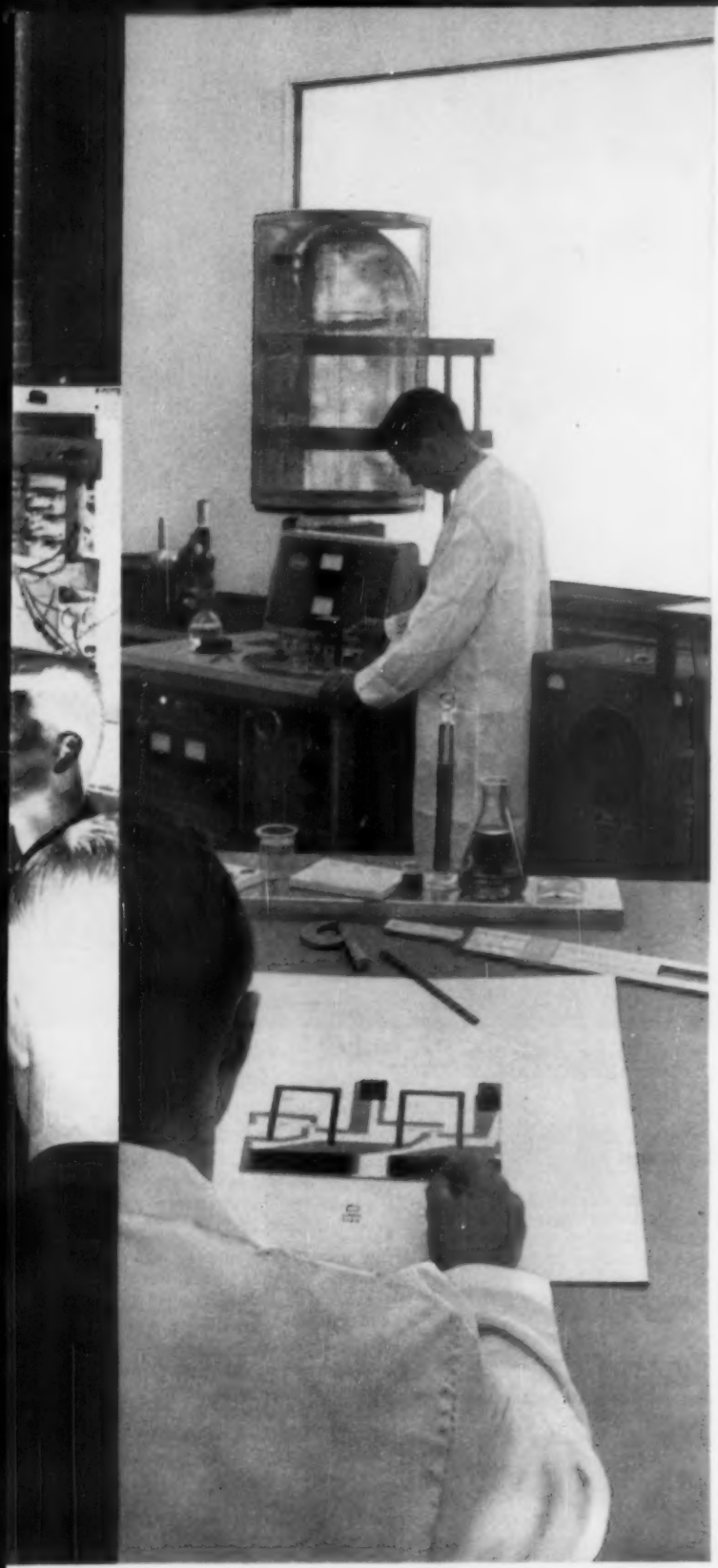
"An incentive-type contract may yield excessive profits because of unexpected decreases in the cost of purchased items considered in setting the final target or because of human errors in estimating the future costs which entered into that calculation. It is of the utmost importance to recognize that, in either case, the contractor has been allowed, at target time, some costs which he will not ever, in fact, incur under the contract, together with a profit thereon; and then, in the final reckoning, he receives a bonus under the incentive formula for not having incurred them.

"This is truly a windfall. It can hardly be claimed that the contractor's efficiency—he might even be inefficient —has played any part in his enrichment. He has done nothing more than show a decrease in costs that were overstated or overestimated in the first place."

A study by the Renegotiation Board of the 25 contractors whose total refunds were the highest during the period from 1951 through 1959 showed that the profits on the fixed price incentive contracts involved averaged 8.8% of sales—substantially less than the 18.3% for fixed price contracts or the 10.6% for price redetermination contracts.

The "surface conclusion" that this indicates that incentive type contracts are more advantageous to the government than fixed price or price redetermination contracts is refuted by a consideration of the profit percentage of net worth of the contractors, Coggeshall told the committee.

"The incentive contractors realized over-all a far greater return on allocated net worth than the fixed-price and price redetermination contractors. Specifically, for the years included in our study, the aircraft and missile contractors, using incentive contracts predominantly (66.7%) . . . and supplied to the extent of approximately 67% with government facilities, realized profits amounting to 71.3% of the total net worth allocated to renegotiable production. During the



EVOLUTION & REVOLUTION

REVOLUTION in electronics may have its genesis in the *evolution* and synthesis of four prime areas: the rapidly maturing technologies of semiconductor development and production, surface passivation and stabilization research, electronic ceramic engineering and controlled thin film deposition. Synthesis of effort in many scientific and engineering disciplines is required to achieve breakthroughs in these areas and accelerate the evolution from conventional to microelectronic circuitry. The Solid State Electronics Department of Motorola's Military Electronics Division is exploiting this approach as the key to long life and reliable performance of electronic equipment by eliminating excessive complexity in component interconnection.

RELIABILITY requires this simplicity of point-to-point contacts, which further yields a substantial size reduction. Highly specialized engineers, physicists and chemists, working at Motorola, are making significant contributions to the state of the art. Other well-qualified scientists and technicians seeking professional growth will find stimulation and challenge in this environment.

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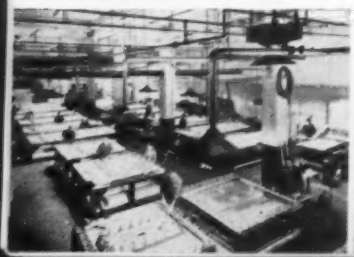

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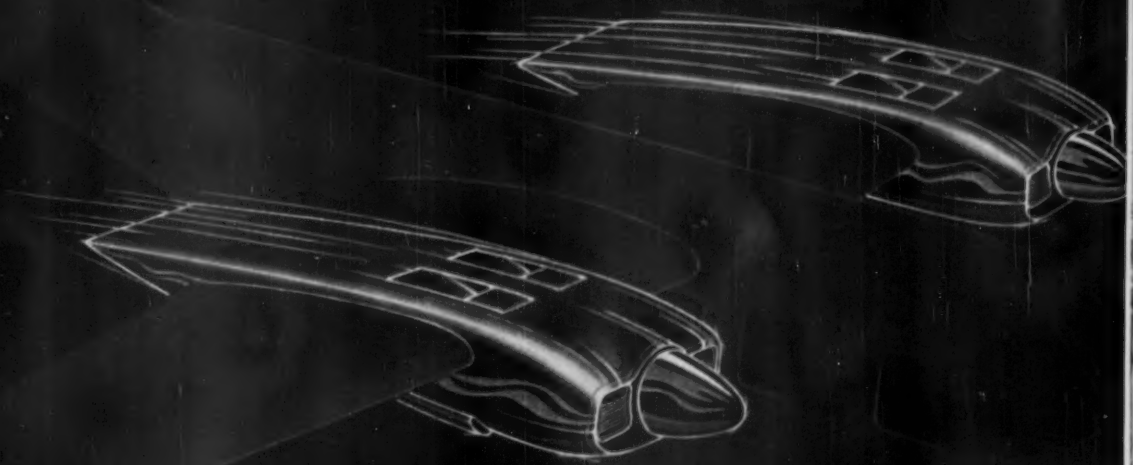

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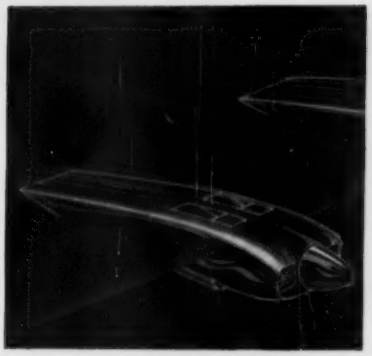

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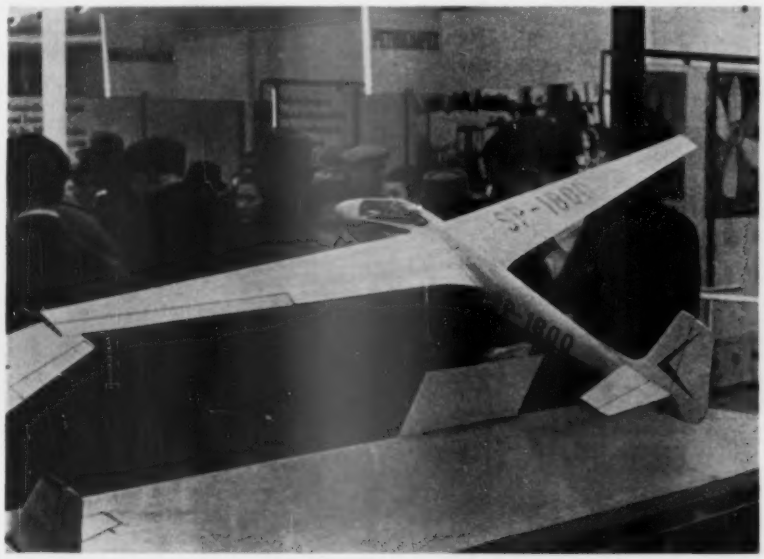
same period, the remaining contractors of the 25 studied, who used mostly their own facilities, and whose sales were made predominantly (95%) under fixed-price and price redetermination contracts, realized only 42.6% of the total net worth allocated to renegotiable production during the study period."

The House Armed Services hearings were part of an investigation of defense procurement policy which the Renegotiation Law extension directed the House and Senate Armed Services Committees to make. The Senate committee has scheduled three days of hearings, May 23-25. The two committees are required to make reports by Sept. 30. Under the law, these will be followed by studies of renegotiation policy by the House Ways and Means and the Senate Finance committees. These studies will be used by Congress in considering further extension of the renegotiation law which expires June 30, 1962.

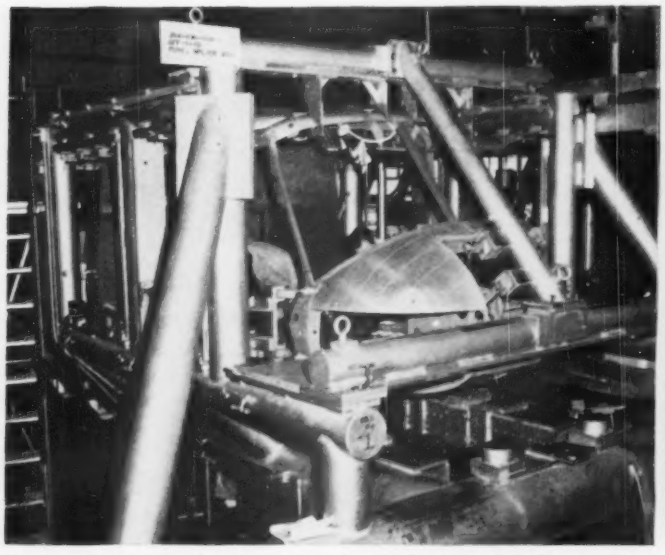
Polish Sailplane, Sport Plane Models

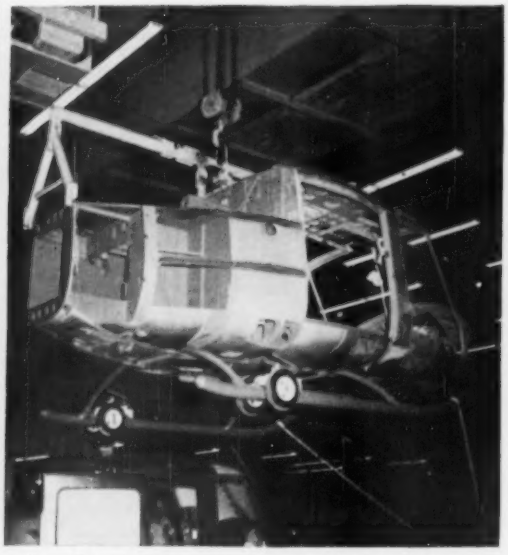
Polish aircraft industry exhibit at Leipzig Technical Fair consisted only of these two models: a competition sailplane and a two-place sport plane. Sailplane is the "Mucha Standard," a single-place glider with a 49-ft. span, 23-ft. length and 5.4-ft. height. Gross weight of the "Mucha Standard" is 670 lb. Placard speed is 155 mph. Two-place sport plane, the PZL-102 "Kos," has a normal cruise speed of 120 mph., and is placarded at 180 mph. Rate of climb at sea level is about 800 fpm. Wingspan is 28 ft., length is 23 ft., and height is 6 ft. Polish sources at the Fair could give no indication of price or delivery status for either aircraft.



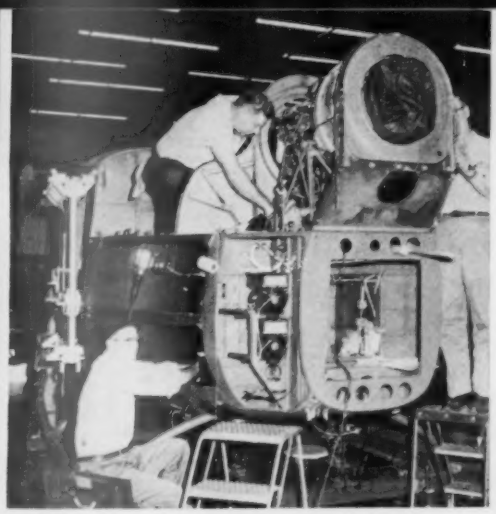
HU-1A Iroquois assembly line at Bell Helicopter Corp.'s Hurst, Tex., plant indicates high production rate for the Lycoming T-53-powered Army helicopter. Detail component assemblies are made up in area at left, then fed into two major assembly jigs at left, rear.

Bell Produces Turbine-Powered HU-1A Iroquois

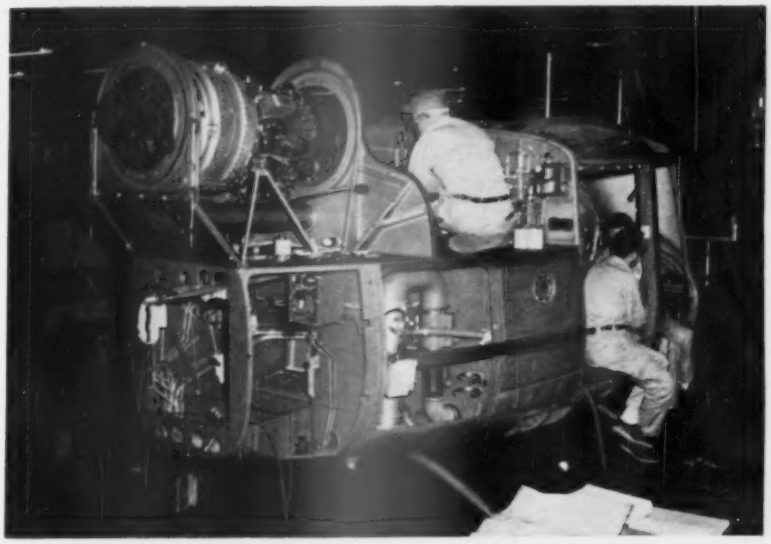




Fuselage components, including left and right hand fuselage beams, roof, nose, firewalls and engine mountings are joined in this massive splice jig (left). Completed cabin sub-assembly then is lifted by a crane to the clean-up position. Fuel bay is just behind cabin door.



HU-1A windshields, brackets, electrical wiring and other detail parts are installed at clean-up stations, above, left. Control hook-up follows, above, right. Rudder, cyclic pitch and other systems are installed under the deck, which has been fitted earlier, but is removed as installations proceed. Lycoming T53 turbine is installed in position at right, and hydraulic lines, more electrical wiring and heater are fitted. Assembly has been lifted by placing skids on blocks to provide room for "creepers" to work under the aircraft. Tail rotor is then mounted sufficiently high to clear obstacles, below, left. Main rotor hub and blade assembly are lifted onto transmission, and near the end of the line all control systems are checked out and hydraulic system is run out under power. Electrical system also undergoes automatic check using mobile circuit analyzer that can check 250 circuits in proper sequence. Wiring is checked prior to entering assembly area.



JUNE 20, 1960 Aviation Week

ARTIST'S CONCEPTION:
GAM-87A SKY BOLT
AIR-LAUNCHED BALLISTIC MISSILE

SAC IN TRANSITION

A Special Aviation Week Report on the Strategic Air Command's Transition into the Aerospace Age

The changing role of the Strategic Air Command in the national defense picture will be featured on June 20th in a special 36-page report prepared by AVIATION WEEK editors with on-the-spot coverage of the SAC Command—The nation's shield against aggression.

This exclusive report will be published in answer to the growing requirement for an improved national understanding of SAC's changing role as the primary deterrent force guarding national security. The annual R&D issue will be devoted to this message which is today's most challenging subject.

The Strategic Air Command's deterrent position has undergone complex and fundamental changes in its transition to a Strategic Aero-Space Command—with its formidable bomber fleet soon to be reinforced by intercontinental ballistic missiles operationally deployed to instantly counter any aggressive action.

The transition of SAC is one of the most rapid and exciting events in the history of our nation and its defense. What SAC needs, what lies ahead and the weapon systems to be employed in the immediate future will be key subjects included in this first-time technical evaluation. The impact of new technologies and weapon systems has changed the entire defense concept and the response of SAC to these new requirements has been effective and positive.

AVIATION WEEK editorial teams are now engaged in the compilation of the new SAC story—one that will generate world-wide readership. This issue, "SAC In Transition," offers manufacturers and suppliers of the aerospace industry an unusual opportunity to advertise and identify their role in the national defense effort.

Aviation Week and **Space Technology**

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Full blast

The Navy's F4D-1 Skyray goes upstairs **fast.** With an afterburner, the Skyray develops 16,000 pounds of thrust, and from a standing start it will climb 50,000 feet in about 2½ minutes.

Douglas Aircraft built the entire front section of the afterburner with Stainless Steel. Stainless can withstand the 1000°F. temperature that builds up here when the Skyray is under full blast. And because Stainless Steel has such exceptional strength, Douglas designers could use it in thinner, **lighter** gages. No other metal can match Stainless Steel's combination of heat resistance, strength, corrosion resistance and economy.

United States Steel makes several types of Stainless Steel for aircraft and missiles. For example, there are USS Types 301, 321, 347 and USS Stainless "W." If you would like more information about any of these remarkable steels, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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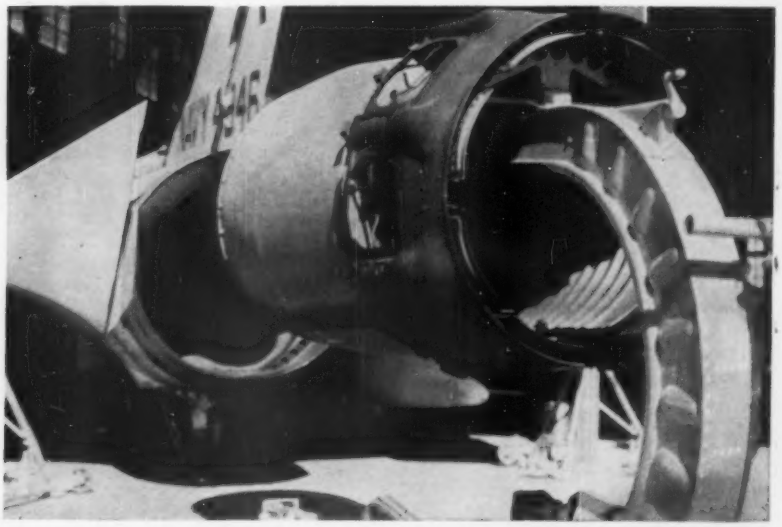
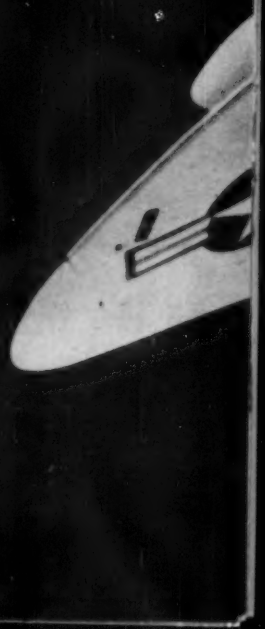




USS United States Steel

CARGO CAPSULES, built by Lockheed Aircraft, are towed to a Pan American World Airways Boeing 707-120 jet transport at Miami in preparation for air cargo service to San Juan, Puerto Rico. Airline says the system can load and off-load cargo in 20 min.

Airlines Evaluate Cargo Packs for Jets

CONTAINERS can hold up to 1,500 lb. each and are lifted into the plane's forward cargo compartment by conventional lifting equipment. Tracks on floor lock containers into place.

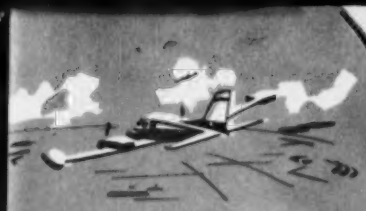
By Barry Tully

New York – Jet-equipped airlines, striving to speed ground handling time, are re-evaluating precontainered cargo packs and improved conveyor systems between aircraft and baggage collection points. The improvement of ground handling, to keep pace with in-flight speed increases, is proving a problem with the large-capacity turbine aircraft. Most major airlines are carrying out studies designed to improve ground handling in general.

System Advantages

The use of cargo packs on routes compatible with this system is growing.

Advantages of the system are that all baggage tagged for a particular destination is placed in one or more similarly marked containers. The containers are then loaded in a logical order and unloaded with the passengers at corresponding stops. This eliminates sifting through baggage holds at each intermediate stop and reduces the possibility of lost luggage. Another ad-



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Now, in areas where there are *no* omni stations or localizers, navigation information, received by the ADF is computed automatically by the CD-4 and presented *visually* on the cross-pointer meter. Because the ADF function is *now* included in the Course Director system, you can fly with precision using the ARC Course Director principle on *all low frequency* facilities.

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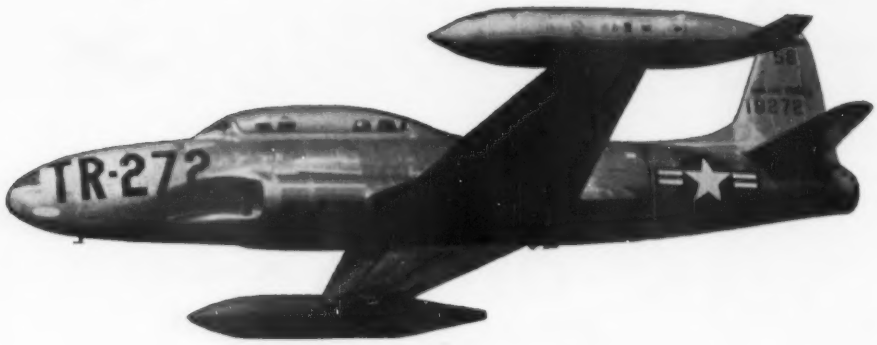
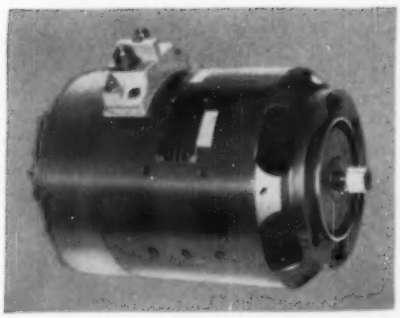


Why jet trainers depend on Bendix Generators



Nothing is more important to the successful training of fledgling airmen than proper equipment . . . equipment that delivers dependable, topnotch performance. That's one of the reasons Bendix Red Bank Generators are so widely used on training aircraft of all types.

Training aircraft rely on Bendix Red Bank Generators to provide the vital electric power for radio, radar, navigation aids, instruments and other equipment.

The 30B43 generator shown is a 400 ampere DC machine. It will produce 300 amperes with 120° C. cooling air. It has a wide speed range (3,000-8,000 RPM), and weighs only 65 lbs. It is ideally suited for use on all types of trainers.

For more information about Bendix Generators and their long record of successful service in all types of aircraft, write to BENDIX RED BANK DIVISION, EATONTOWN, NEW JERSEY.

West Coast Office: 117 E. Providencia, Burbank, Calif. Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. Canadian Affiliate: Aviation Electric, Ltd., P.O. Box 6102, Montreal, Quebec.

Lockheed's T-33 and North American's new T2J are equipped with Bendix Red Bank Type 30B43 DC Generator. Makes good sense to train air cadets in the finest trainers equipped with the finest accessories!

Red Bank Division
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vantage of the packs is protection from rain during bad weather.

The cargo packs are even more useful in handling cargo than luggage, according to some airlines not employing the luggage containers. In addition to providing protection from weather and pilferage, the cargo containers may be loaded during off peak hours and put aboard the aircraft by two or three men, thus distributing the work load.

In some cases the packs are loaded by the shipper, merely handled by the airline and trucking service, and opened at the ultimate destination.

The cargo packs are designed to fit the cargo hatches of particular aircraft. When loaded, they are towed on special trailers to the aircraft where they are placed aboard by means of electric hoists or fork lifts.

Tracks permit the containers to be placed forward or aft within the cargo hold.

The containers are then locked into position to prevent shifting in flight. The process is reversed to offload any or all of the containers at a terminal.

Weight Penalty

Disadvantages of the cargo pack system are that it necessitates a weight penalty of about 1,000 lb. and a slight reduction of volumetric capacity. Cables which would jump the track and jam caused the major difficulty. United and American, however, two leading proponents of the system, report that their systems now are functioning reliably. Additionally, a lack of system reliability, in some cases, has proved discouraging. System reliability is of extreme importance if time savings are to be realized. Proponents of the system, however, say that its use will continue to spread throughout the major airlines.

New airline terminals are speeding passenger baggage handling with improved routing of departure and arrival baggage, utilizing moving belt conveyor systems. One noticeable improvement at some terminals is the distribution of arrival baggage on a long counter which eliminates the frustrating melee around baggage return points. While not all new terminals employ the system, greater emphasis on baggage handling in terminal designs is providing a general improvement.

Among the major airlines surveyed by AVIATION WEEK regarding baggage handling were:

• **United Air Lines,** employing a container system of its own design on its Douglas DC-8 transports. The glass fiber containers, each holding 25 bags, are hoisted into the belly of the transport by means of electric hoists. The airline says it is pleased with the system's speed of operation and for the protection given to passengers' luggage. Due to limited clearance on the Boeing 720 ordered by the airline, the system will not be installed on that aircraft. The Boeing aircraft is too low to the ground to permit clearance for the container trailers. A side-loading system could be developed for the Boeing; however, at present the airline plans to hand-load the aircraft.

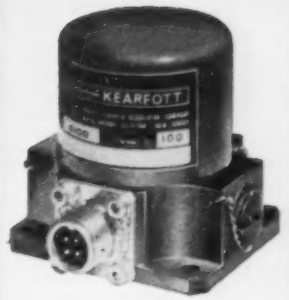
• **Pan American,** hand-loading luggage on its transatlantic flights, is presently evaluating a Lockheed-developed cargo pack system on its Miami-San Juan and New York-Miami routes. The system, employing roller-bearing platforms, switching platforms and tracks in the forward cargo hold, will load or unload 9,000 lb. of cargo in 10 min. from a Boeing 707. The cargo is carried in six aluminum containers of 1,500-lb. capacity. The Boeing Intercontinental 707-321, if fitted with the necessary tracks, will hold seven cargo packs in the forward hold. Pan American says that the system has particular advantages on trips from New York to San Juan which proceed to Miami under a new flight number after a short stop. The one intermediate stop for unloading cargo makes the use of cargo packs particularly advantageous. Pan American says that it is studying the possible use of prepackaged cargo on its transatlantic operation.

• **Eastern Air Lines,** hand-loading baggage on its Douglas DC-8 and Lockheed Electra flights. The airline feels that this is the most efficient loading method for its particular operation. At Eastern's Idlewild and Miami terminals, conveyor belts are used to increase handling speed and reduce the number of personnel employed.

• **American Airlines,** using loaded baggage containers on its Boeing 707 flights. The airline had originally installed the system on its Lockheed Electras; however, with the shift of the Electras to shorter-haul operation and the emphasis on carry-on baggage, the container system was discarded on this aircraft. The airline is satisfied with the operation of the container system on its jets, primarily due to increased speed of handling and baggage protection. American has used a cargo box on its cargo aircraft for some years with considerable success.

• **Trans World Airlines,** hand-loading baggage on its jet flights. The airline reports that it is studying various loading methods under a program to improve jet ground-handling operations. TWA will begin evaluation of the Douglas Glide-Aire system for loading luggage containers in May. This system, developed for cargo handling, employs compressed air jets to permit the sliding of heavy containers over a smooth surface (AW May 2, p. 148).

BASIC BUILDING BLOCKS FROM KEARFOTT



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Kearfott's unique approach to electrohydraulic feedback amplification design has resulted in a high-performance miniature servo valve with just two moving parts. Ideally suited to missile, aircraft and industrial applications, these anti-clogging, 2-stage, 4-way selector valves provide high frequency response and proved reliability even with highly contaminated fluids and under conditions of extreme temperature.

TYPICAL CHARACTERISTICS

Quiescent Flow ..... 0.15 gpm
Hysteresis .. 3% of rated current
Frequency Response 3 db @ 100 cps
Supply pressure....500 to 3000 psi
Temperature-Fluid & Ambient −65° F to +275° F
Flow Rate Range .... .3 to 10 gpm
Weight ..... 10.5 ounces

Write for complete data.

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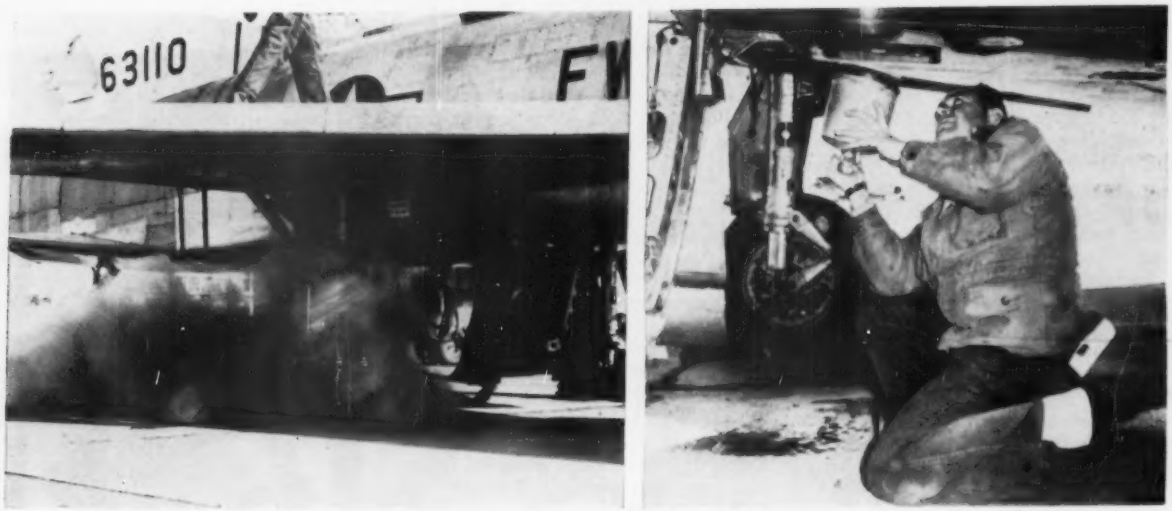


PROPELLANT cartridge, plugged into the belly of a North American F-100 fighter, permits unassisted engine starts at a touch of a cockpit button. The turbojet starter unit is compatible with conventional compressed air starts.

USAF Adapts Cartridge Starter to F-100

Propellant cartridge turbojet starters, designed for the Republic F-105 tactical aircraft, are being fitted to Tactical Air Command North American F-100 D and F series fighters.

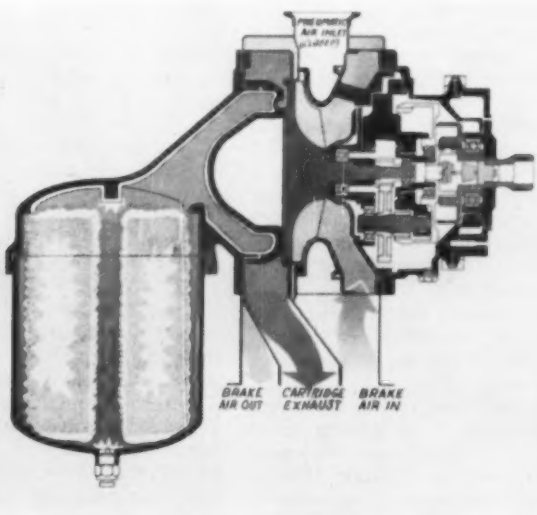
The 615th Tactical Fighter Squadron, England AFB, La., is the first F-100 unit to receive the cartridge starters which permit engine starts independent of external ground power. A third application of the unit will be to start the Pratt & Whitney J52 turbojet engine of the North American Hound Dog air-to-ground missile. Three versions of the starter are required by the three Pratt & Whitney engines: the F105's J75, the F-100's J57 and the Hound Dog air-to-ground missile's J52.

The cartridge starter, developed by the AiResearch Mfg. Division of The Garrett Corp., Phoenix, Ariz., is a dual-purpose unit permitting conventional compressed air starts as well as cartridge starts. This provides "scramble" capabilities while permitting compressed air starts under normal operating conditions or when propellant cartridges are unavailable.

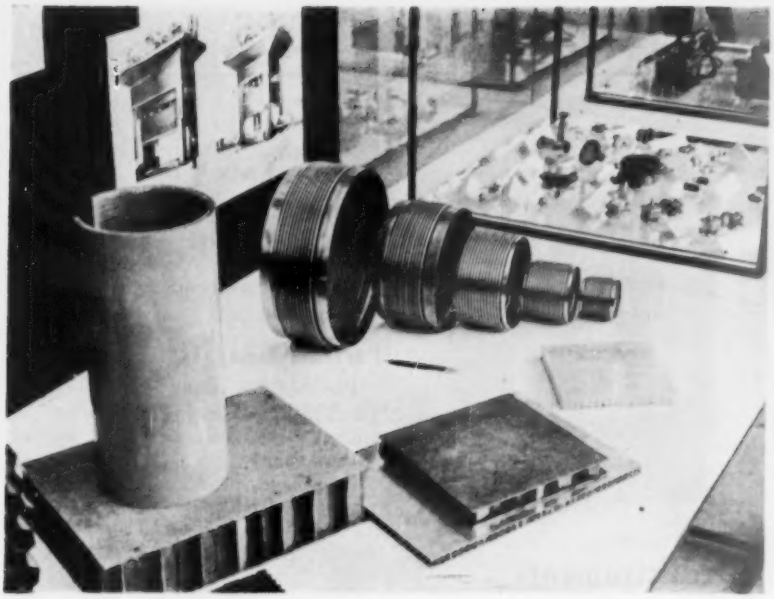
The starter consists of cartridge chambers, plenum scroll, combination turbine wheel, reduction gearing, engaging mechanism and splined output shaft. The turbine wheel is double-faced. One wheel face has conventional vanes for operation with ground-supplied compressed air. On the back of this wheel are impulse turbine buckets which produce equivalent power (150 hp.) from propellant gases.

Cartridge chambers and scroll control either gas or air flow by means of separate nozzles and discharge passages. The gear housing encloses splash-lubricated turbine bearings, gear system and engaging mechanism.

The upper cartridge assembly is bolted to the scroll assembly. The removable cartridge chamber, which holds an Air Force type MXU-4 A cartridge, is fitted to the front cartridge chamber



TURBOJET starter turbine produces approximately 150 hp. from 8 lb. propellant cartridge or compressed air flow. Diagram (right) shows alternative flow routes to double-face turbine wheel, permitting cartridge or air starts.



East Germans Display Honeycomb Structures

Honeycomb structural samples and a series of stainless-steel expansion joints indicated some of the directions of component and materials research in the East German aircraft industry. Displayed at the Leipzig Technical Fair, the honeycomb samples showed were typical of conventional test or construction specimens, included metal or hardboard with paper cores (foreground) and a plastic core and skin sample (background). Expansion joints varied in size from 3-in. diameter to 18 in., and in length from 3 to 6 in.

by means of a bayonet-type fitting.

The plenum scroll is bolted to the gear housing assembly. Within the plenum, an inner housing provides support for the pneumatic nozzle which directs cartridge exhaust gases and air discharged from the aerodynamic face to an exhaust port.

Electrically Armed

The cartridge is electrically armed when the removable cartridge chamber, containing a solid propellant charge, is connected to the front chamber by means of the bayonet fitting. This is accomplished by ground personnel without any tools.

The cartridge is fired upon actuation of a cockpit button. Gases generated by the burning propellant flow through the upper cartridge chamber and the hot gas nozzle, then are directed on the turbine wheel and exhausted through the upper cartridge chamber and the hot gas nozzle, then are directed on the turbine wheel and exhausted through a port in the plenum. Torque generated by the turbine is transmitted through the reduction gear system and engaging mechanism to the splined output shaft.

This shaft is coupled directly to the engine turbine.

When the engine starts, the spring-loaded pawls of the engaging mechanism are disengaged by centrifugal force at 3,000 rpm. Starter overspeed, in the event of disengagement of the engine prior to cartridge burnout, is prevented by the braking action of aerodynamic vanes on the front face of the starter turbine.

A safety plug in the upper cartridge chamber is designed to rupture in the event of critical overpressures. Additionally, the starter unit is designed to contain any structural failures preventing any damage to the engine.

Compressed air starts with the starter are possible with any equipment which supplies air at 50 psia. and 350F.

Boeing Gas Turbine Will Power DSN-3

Boeing 502 turboshaft engine will be installed in Navy's Gyrodyne DSN-3 drone anti-submarine helicopter intended to operate off destroyer decks in Dash (Destroyer, Anti-Submarine Helicopter) operations. The small, unmanned helicopter will be armed with a homing anti-submarine torpedo. The engine, built by Boeing Industrial Products Division, will attain 270 hp. takeoff rating at 5,950 rpm. Engine installation will be cantilevered from the helicopter transmission. Boeing describes it as a simple-cycle, two-shaft turbine with a gas producer turbine wheel with mechanically attached turbine blades of a new high-temperature, high-strength alloy.

BASIC BUILDING BLOCKS FROM KEARFOTT

FERRITES

Kearfott's Solid State Physics Laboratory formulates, fires and machines permanent magnet ferrite materials of various compositions. Typical high-efficiency array utilizes Kearfott PM-3 ferrite material with specially designed pole pieces to produce a design both smaller and lighter than other arrays of equivalent magnetic field strength. Because magnets may be custom engineered to specific requirements, user is not restricted to stock magnet types, thereby providing greater latitude in parameters for focusing arrays. Pole pieces may also be provided according to specification, with the added assurance that, because of special Kearfott design techniques, B axial magnetic fields approximately 10% higher than those generally obtained in standard types may be produced.

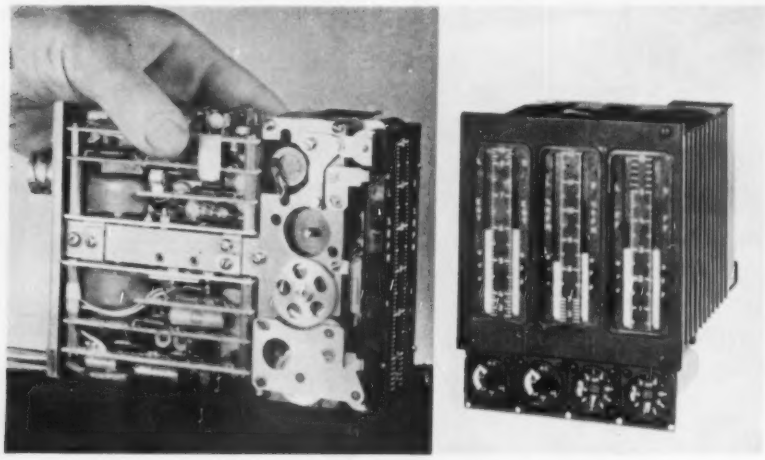
TYPICAL CHARACTERISTICS

Peak Magnetic Field Strength	1200 gauss
Period	0.560 in.
Length	5.64 in.
Inside Diameter of Pole Pieces	0.400 in.
Outside Diameter	2.0 in.
Weight	3.2 pounds

Write for complete data.

KEARFOTT DIVISION
GENERAL PRECISION INC.
LITTLE FALLS, NEW JERSEY

NEW AVIATION PRODUCTS



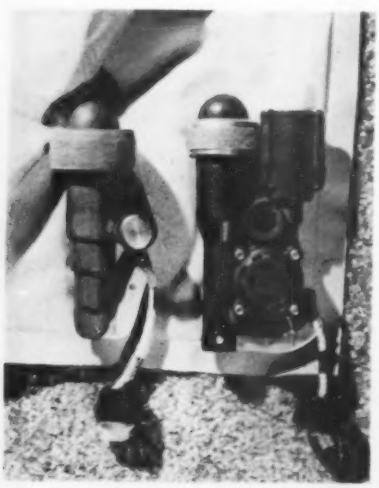
Grumman A2F-1 Engine Instruments

Vertical-column indicators are used to display performance data of the two Pratt & Whitney J52 engines on the Grumman A2F-1 Navy attack aircraft (AW May 9, p. 94). The instruments (left to right) provide exhaust gas temperature, percentage of rpm. and fuel flow information. Dials beneath the vertical-column indicators provide power trim and oil pressure readings. The servo-driven, null-balancing instruments were developed for the A2F by the General Electric Co.

Life Vest Inflator

Water-activated life vest inflator punctures a standard carbon dioxide cartridge upon immersion in water.

The actuator, employing a printed electronic circuit, will withstand ex-



posure to 100% humidity without opening. Other applications include emergency life rafts and missile recovery systems.

Air Cruisers Division, The Garrett Corp., Belmar, N. J.

Jet Navigation Computer

Aluminum computer for solving wind and true airspeed problems is intended for jet transport pilots.

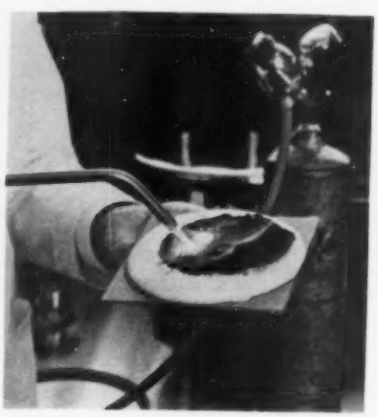
Model 220-V2 computer, available in black-on-white or white-on-black for night use, solves drift angle and ground speed, ADF problems and true air speed to 700 kt. from true or indicated outside air temperature. Cost is $10.95 for the day model, $13.95 for night presentation.

Plumly Mfg. Co., Fort Worth 16, Tex.

Heat Resistant Coating

Coating material is used to coat neoprene-jacketed missile umbilical cables providing increased heat resistance. The material has been tested on umbilical cables during Atlas missile firings.

Dyna-Therm 65, of phosphate and boron flameproofing chemicals dispersed in a polyurethane binder, expands and



bubbles upon the application of heat, thus insulating the material underneath. The white insulating material has been exposed to temperatures to 6,000F. If necessary, cables may be recoated with Dyna-Therm 65 after exposure to heat. Sales agent for the product will be Swedlow Inc., Los Angeles.

Dyna-Therm Chemical Corp., Culver City, Calif.

Portable X-Ray Tester

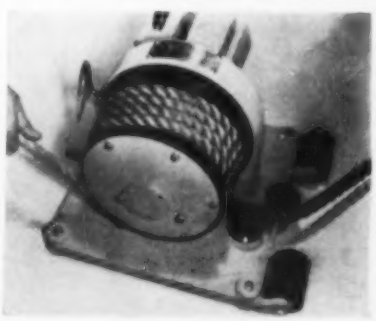
Portable X-ray unit provides radiographic, non-destructive inspection of aircraft structural members, control surfaces and welds.

The X-ray machine is used during periodic aircraft checks and following hard landings and unusually turbulent flights. X-ray plates provide a permanent visual record and can measure growth of known fatigue cracks by comparing plates exposed over cracks at progressive intervals.

Baltean Electric Corp., Stamford, Conn.

Rope Winch

Rope winch for loading and unloading cargo aircraft weighs 67 lb. and exerts a drawbar pull of 2,500 lb. The winch can move skid packages of 2½



tons, or rolling loads of 75 tons, on a single line.

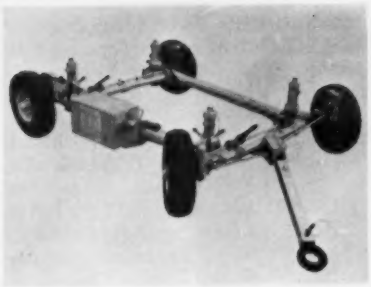
Model 51 rope winch has a hauling speed variable from 0 to 26 fpm. and exerts a pulling force in a direct ratio to the amount of tension applied by the operator. The winch is available with 28 v.d.c. or 400 cps. a.c. motors. The winch is equipped with anchor hook tie downs and neoprene rollers to assist movement.

Air Cargo Equipment Co., 1121 E. Colorado St., Glendale 5, Calif.

Component Handling Trailer

Component trailer is designed to handle airborne systems and components weighing up to 3,000 lb.

The coil spring trailer provides positive control of load position in pitch,



roll and elevation; straddle capability; and individual 90 deg. wheel positioning.

Northrop Corp., Norair Division, 1001 E. Broadway, Hawthorne, Calif.

Radio Antenna Reel

Motor-operated reel is designed for trailing wire radio antennas on supersonic aircraft. The reel is said to be designed for an antenna which enables messages to be transmitted with 95% of power instead of the conventional 40%.

The weighted antenna extends 150 ft. from the reel, or is halted at any point by means of a brake which has a 500 in./lb. holding force. A cockpit indicator registers the length of the cable. Cable rewinds at 3 fps. upon actuation of the 115 v., three-phase, 400 cps. a.c. motor capable of a 90 lb. pull. The gear train, brake and motor are enclosed in the reel which measures 4.06 in. in diameter, 5.4 in. in length and weighs 6.5 lb. An explosive-actuated shear piston permits severing an unreeled cable.

General Controls' Aircraft/Electronics Division, 1320 S. Flower St., Burbank, Calif.

WHAT'S NEW

Publications Received

Advances in Astronautical Sciences Vol. 4—Plenum Press, Inc., 227 West 17th St., New York 11, N. Y. $8.00. From reports presented at the Fifth Annual Meeting of the American Astronautical Society, held December, 1958; the scientific and technological progress of astronautics and original technical research from both theoretical and experimental aspects.

Space Flight—Vol. I.—Environment and Celestial Mechanics—Krafft A. Ehricke—D. Van Nostrand Company, Inc., Princeton, N. J. $14.50. This volume covers concept of space flight and the environment in which it will take place.

Burner Simulates Aerodynamic Heating

This 10 million Btu./hr. pebble burner heater, part of a unit to simulate heating effects encountered by aircraft and missiles, was developed for Douglas Aircraft's Aerophysics Laboratory by Hirt Combustion Engineers, Montebello, Calif. Burner heats air to temperatures ranging from 300F to 3,500F. Complete unit will be mounted in Aerophysics' 27 in. wind tunnel at the El Segundo Division.

BASIC BUILDING BLOCKS FROM KEARFOTT

INTEGRATING TACHOMETERS

Kearfott integrating tachometers, special types of rate generators, are almost invariably provided integrally coupled to a motor. They feature tachometer generators of high output-to-null ratio and are temperature stabilized or compensated for highest accuracy integration and rate computation. Linearity of these compact, lightweight tachometers ranges as low as .01% and is usually better than ± .1%.

TYPICAL CHARACTERISTICS

	Size 11 (R860)
Excitation Voltage (400 cps)	115
Volts at 0 rpm (RMS)	.020
Volts at 1000 rpm (RMS)	2.75
Phase shift at 3600 rpm	0°
Linearity at 0-3600 rpm	.07
Operating Temperature Range	−54° +125°

Write for complete data.

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to the extent that is known at this time. Emphasis is placed on the useful comprehensive tables on consistent data and of the graphs and illustrations as well as hand calculation and short-cut methods given in the celestial mechanics chapter.

First Into Outer Space—Theodore J. Gordon & Julian Scheer—St. Martin's Press, 175 Fifth Ave., New York 10, N. Y. $3.95. An account from inside a blockhouse of a U.S. "first" into outer space.

The Seven Skies—John Pudney—Putnam, 42 Great Russell Street, London. Approximately $4.20. (30 shillings) A record and ancestry of British Overseas Airways Corp., the pioneering routes to India and Australia, down the African continent and the wartime achievements. The author had the collaboration of the management and staff of the airline to aid and augment this account.

Aircraft and Missile Design and Maintenance Handbook—by Charles A. Overbey—The Macmillan Co., 60 Fifth Ave., New York 11, N. Y., $9.75; 369 pp. Illustrations and explanations of equipment installation and maintenance. Electrical and plumbing systems, materials of construction, aircraft and missile hardware, color codes and conversion systems and various processes are among topics covered.

Air Traffic Control—C. D. Colchester—Marconi's Wireless Telegraph Co., Ltd., Marconi House, Chelmsford, Essex, England. Approx. $2.46, 100 pp. A report compiled from such sources as the Ministry of Transport and Civil Aviation, the Air Traffic Control Experimental Unit at London Airport and General Precision Laboratories, dealing with traffic control development and its present state.

Nondestructive Testing Proceedings—First National Symposium on Nondestructive Testing of Aircraft and Missile Components. San Antonio, Tex., 1960. An outline of some testing problems and how they were solved by the aircraft industry.

Fire Control Principles—Walter Wrigley and John Hovorka. McGraw-Hill Book Co., Inc., 330 W. 42nd St., N. Y. 36, N. Y. $10.00, 133 pp. Book describes the basis physics and geometry applicable to any fire control problem. Methods of solution and the instrumental techniques applicable to all fire control systems are discussed.

Famous Bombers of the Second World War—William Green—Hanover House, 575 Madison Ave., N. Y. $3.95. Stories of the bombers employed by Britain, the U.S., Germany and Italy along with drawings bearing full operational markings.

Moon Base—John F. Rider Publisher, Inc., 116 W. 14th Street, New York, N. Y., $1.95, paperbound, 80 pp. Based on the technical and psychological factors of the U. S. team of human beings to be sent to the moon.

U.S. Marine Corps Aircraft 1914-1959—William T. Larkins—Aviation History Publications, Post Office Box 624, Concord, Calif., $5.00. A pictorial history of USMC aircraft (490 photographs).

Twenty Seconds to Live—Elizabeth Land—E. P. Dutton & Co., Inc., 300 Fourth Ave., New York 10, N. Y. Story of USAF copilot Lt. James Obenauf who landed a stricken Boeing B-47 safely, saving an unconscious crew member.

The Rocket Handbook for Amateurs—Lt. Col. Charles M. Parkin, Jr.—The John Day Co., New York. $5.95. This handbook was prepared to show amateurs the type of basic knowledge essential to the safe construction, testing and launching of rockets.

The success or failure of a missile can easily depend on the positive sealing of the fluid systems which activate or control its flight. Stillman Rubber Company, with its years of experience in the aircraft and missile fields, has perfected Still-Seal Gaskets for static sealing, and Permadized Seals for quasi-static sealing of fuel systems, hydraulic lines, and other systems which must be absolutely leak-proof to be effective. Using special Stillman compounds and the exclusive Stillman Permadizing process for bonding rubber to metal, Stillman products have become the "most specified" seals and gaskets in the aircraft and missile markets. These same quality products are available and are being sold to industry where critical sealing problems exist, and where only the best in sealing is good enough. You can design Stillman seals and gaskets into your products and add a new measure of efficiency to the functions they perform.

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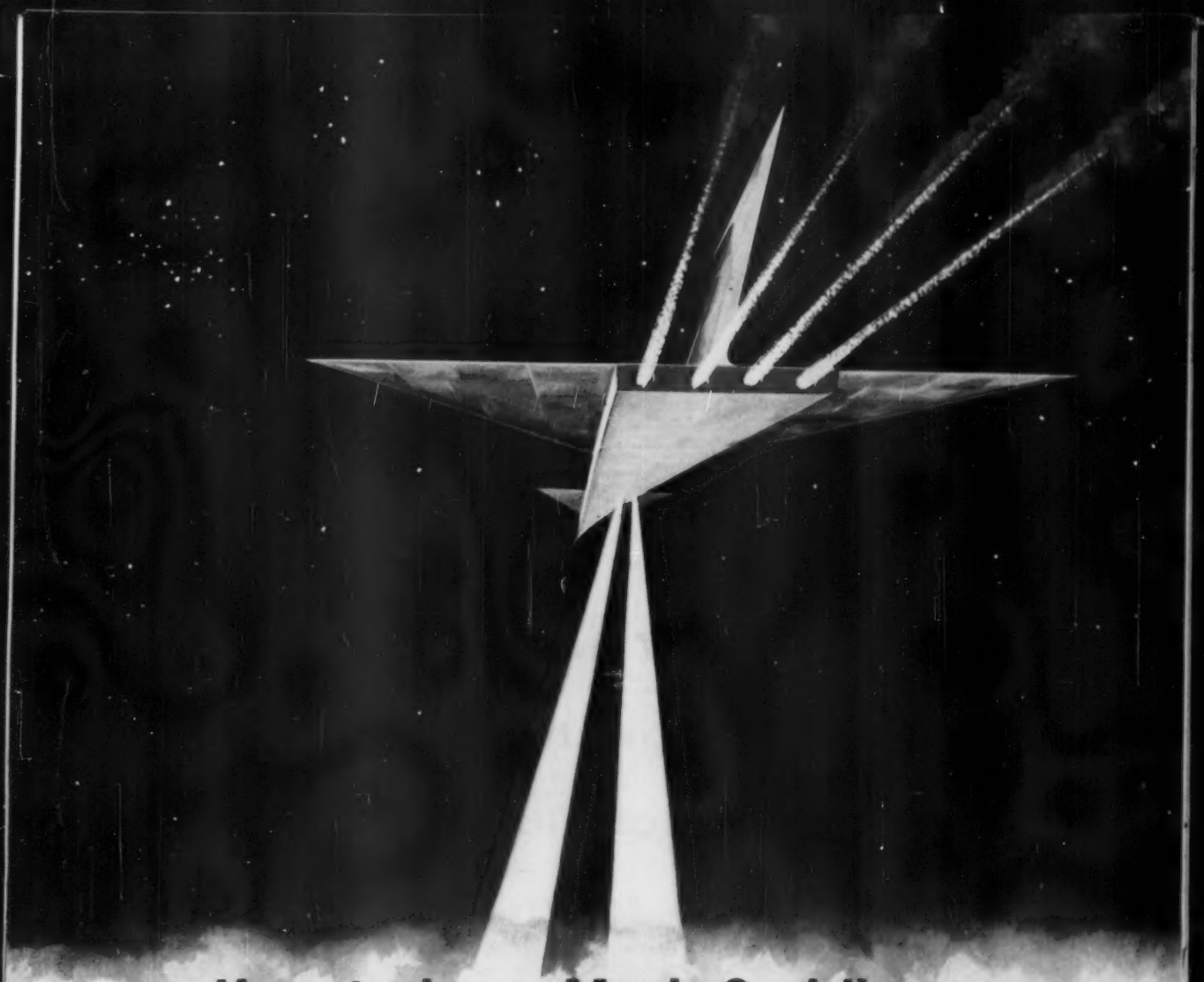

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RYAN ELECTRONICS

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Dr. Hans E. Hinteregger has been selected by the Geophysics Research Directorate as the Guenter Loeser Memorial Lecturer for 1960. The lecture will be held in the Lexington High School Auditorium, Lexington, Mass., June 1, 3:00 P.M.

Federal Aviation Agency Administrator **Elwood R. Quesada** has received the Monsanto Chemical Co.'s 1959 Aviation Safety Award for his "vigorous implementation of the Federal Aviation Act of 1958."

James C. Fuller of Bell Helicopter Corp. has been named America's No. 1 aviation public relations man by the Aviation Writers Assn. Mr. Fuller was cited for work in encouraging establishment of heliports and his activities in behalf of aviation generally.

Frederick D. Braddon, chief engineer of the Marine Division of Sperry Gyroscope Co., has received the Elmer A. Sperry Award for 1960 for outstanding contributions to the field of transportation.

J. W. Keating, manager of Aerojet-General's Solid Rocket Plant Propellant Processing Division, has been selected for an Alfred P. Sloan Fellowship for a year of management study at Massachusetts Institute of Technology.

Changes

Hal M. Thomas, program manager, and **Ted J. Gordon,** project engineer, for the Saturn second-stage program, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Lear, Inc., Los Angeles, Calif., has announced the following appointments: **Fernand H. Matile,** director of European sales; **Robert J. Richardson,** staff assistant to the director of European operations; **Wayne E. Burklund,** director of European service.

Harold T. Luskin, program manager for providing advanced Agena satellites to the National Aeronautics and Space Administration, Lockheed Missiles and Space Division, Sunnyvale, Calif.

Martin C. Hemsworth, manager of engineering, General Electric Co.'s Small Aircraft Engine Department, Lynn, Mass.

William J. Brackmann, director of research and engineering, ASCOP Division of Electro-Mechanical Research, Inc., Princeton, N. J.

Dr. Stephen J. Angello, manager of molecular electronics programs, Westinghouse Electric Corp.'s Air Arm Division, Baltimore, Md.

Michael A. Moscarello, chief engineer, Ford Instrument Co., a Division of Sperry Rand Corp., Long Island City, N. Y.

Ryan Electronics, Division of Ryan Aeronautical Co., San Diego, Calif., has announced the following appointments: **S. W. Hedrick,** chief customer engineer; **Norman V. Gomes,** chief of operations analysis; **W. J. Harmeyer,** chief of budgets.

Dr. James M. Carter, director of the Physical Sciences Division of Space Systems Laboratories, Burbank, Calif.

Dr. Alan G. Stanley, assistant director of research, General Transistor Corp., Jamaica, N. Y.

Leonard D. Sullivan, manager of Raytheon Co.'s Washington, D. C., office.

Dr. David Van Meter, manager, and **John W. Gerdes,** assistant manager, Applied Science Division of Melpar, Inc., Watertown, Mass., a subsidiary of Westinghouse Air Brake Co.

Dr. Elmer L. Zimmerman, head of nuclear circuitry research, Hughes Aircraft Co.'s Nuclear Electronics Laboratory, Los Angeles, Calif.

C. L. Hewitt, manager of sales, Missile Systems Division of Republic Aviation Corp., Farmingdale, N. Y.

Herbert A. Cohen, manager, Space Instrumentation Division of Acton Laboratories, Inc., Acton, Mass., a subsidiary of Technology Instrument Corp.

Ray D. Gardner, chief engineer, Horkey-Moore Associates, Torrance, Calif., a subsidiary of Houston Fearless Corp., succeeding **John N. Kerr,** who continues as vice president-engineering.

George W. Fenimore, general manager of Thompson Ramo Wooldridge's newly established International Division, Canoga Park, Calif.

Aerojet-General Corp., Azusa, Calif., has appointed **Dr. Thomas T. Omori** European manager of the NATO-Aerojet Propulsion Program-production of motors for the Hawk missile, with headquarters in Paris, France.

E. Floyd Sherman, director of program development, Systems Laboratories Division of Electronic Specialty Co., Los Angeles, Calif.

Robert M. DeHaven, manager-flight test division, Hughes Aircraft Co., Culver City, Calif.

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Wanted: Radio Shop Manager. Established Repair Station specializing in corporate owned multi-engine aircraft. Requires an experienced man capable of designing complete electronic systems and supervising operation of radio shop. Excellent opportunity. Send complete resume to P-4371, Aviation Week.

Aircraft Specialists—Openings available for well experienced Class "A" sheet metal specialists and Class "A" licensed airframe and powerplant mechanics. Top working conditions, good pay with usual benefits. Mattituck Airbase Corp., Linden Airport, Linden, New Jersey.

Immediate opening for experienced co-pilot with major oil company. Applicant must have minimum of 1500 hours, commercial license, instrument with MEL and A & P ratings. Prefer Beechcraft or DC-3 experience. Send full particulars and photograph to Ray Higgins, 1608 Walnut Street, Philadelphia 3, Penna.

POSITIONS WANTED

Mech. Engineer, living in Canada. 16 years experience in Aircraft and Engine, seeks a position with responsibility. Previous experience: inspection, research, maintenance, design, in supervisory and managing positions. PW-4263, Aviation Week.

Design Weight Engr.—8 yrs. exper. airframe, missile, engines & small turbines; Degree equiv. retired Naval Pilot, Married; Ref. & Resume available. L. C. White, 1034 Neptune, Chula Vista, Calif.

Executive: 15 years aero. mech. Electronics engineering and business experience. Three eng. degrees P.E. and patents. Age 39. Desire position requiring leadership. $25,000 with options. Outstanding record with references. PW-4387, Aviation Week.

Executive and airline ATR Pilot 14000 accident free hours SMEL 2000 hours Atlantic routes interested sales customer relations plus flying Canadian and American licenses. 47 years old, married, living Toronto. PW-4418, Aviation Week.

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DIGITAL SYSTEMS AND LOGIC DESIGNER

Familiar with digital logic techniques at current state of the art; capable of organizing computing systems to perform various tasks including logical design and critical parameter specification.

ELECTRONIC ENGINEER

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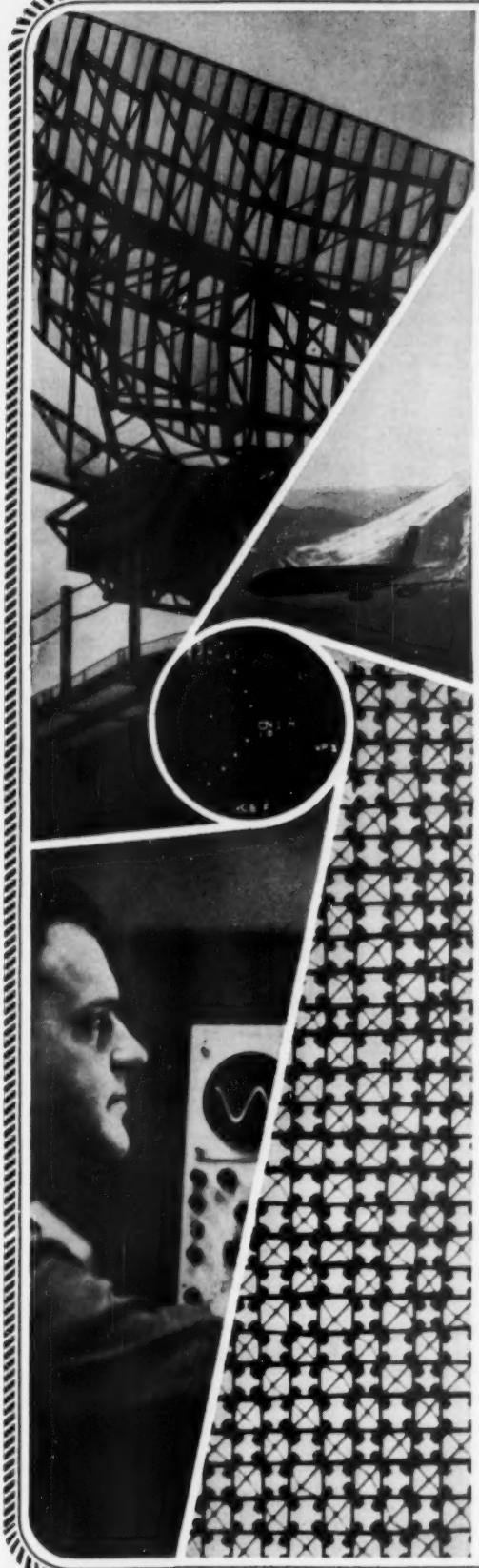

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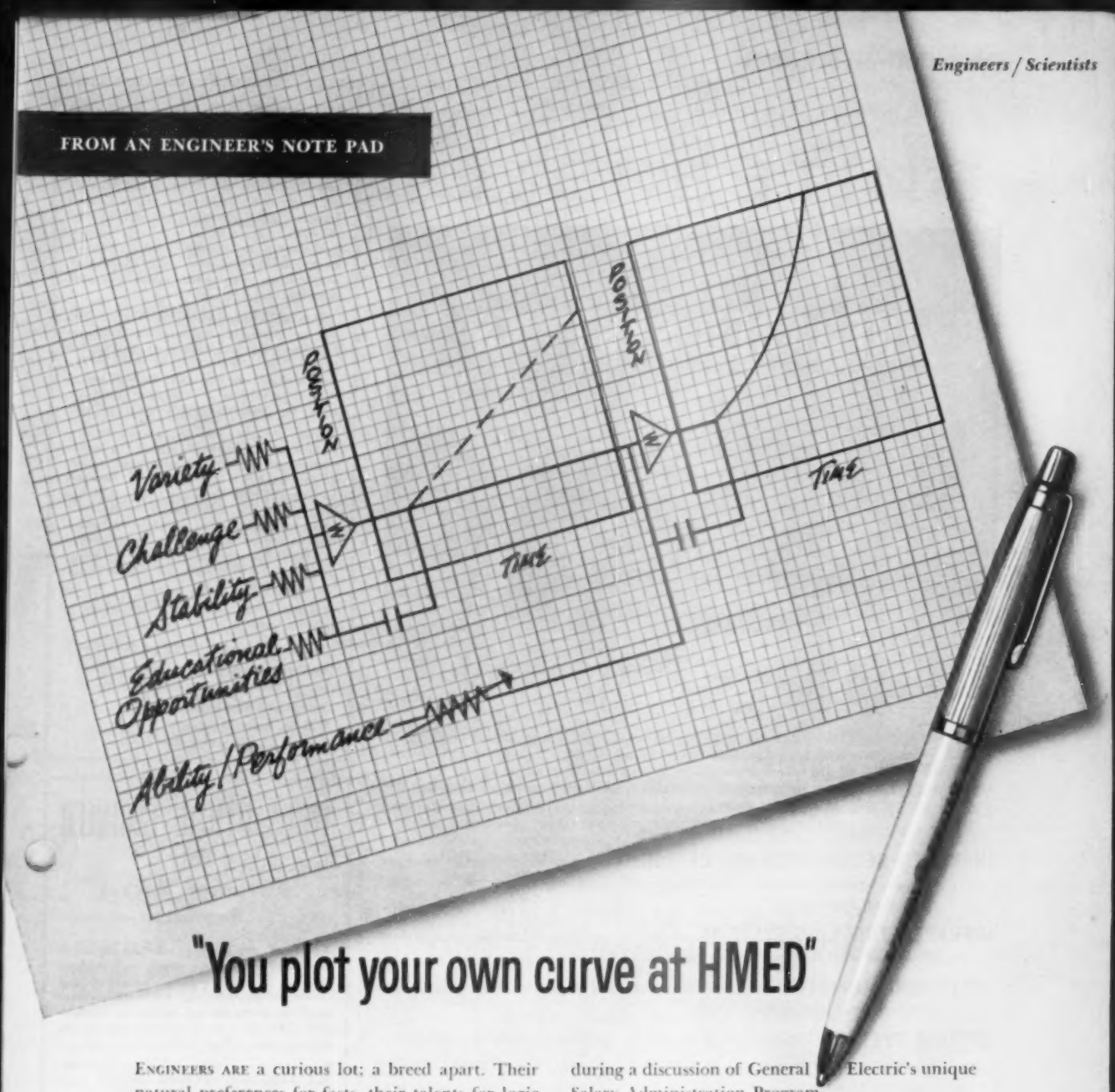
Engineers / Scientists

FROM AN ENGINEER'S NOTE PAD



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One result of our X-15 Adaptive Autopilot effort has been the creation of a permanent reaction control system and development section which has been assigned to our Components Design Department.

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Requires background in missile propulsion systems analysis as it relates to reaction controls. Must be able to establish reaction control requirements by analysis of vehicle dynamics and have an understanding of propellant fuels and oxidizers for specific systems; handle heat transfer problems to optimize and compare several concepts for a given duty cycle; determine optimum over-all performance characteristics, thrust response with given inputs, and chamber pressure and oxidizer-fuel ratios for various nozzle heat sink designs; assist on all proposal efforts requiring propulsion system analysis.

REACTION CONTROL DEVELOPMENT ENGINEERS

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If you are a qualified engineer, we would like to hear from you. Just drop a line including pertinent information on your background, interests, and accomplishments to Mr. James Burg, Dept. 660, Honeywell Aeronautical Division, 1433 Stinson Blvd. N.E., Minneapolis 13, Minn.

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, MAY 16, 1960

AERO DESIGN & ENGINEERING CO. 130-131
AEROJET-GENERAL CORP. ..... 2nd Cover
AEROQUIP CORPORATION 11
AIR PRODUCTS, INC. 112
AIRBORNE ACCESSORIES CORP. 6
AIRCRAFT RADIO CORPORATION 139
ALLMETAL SCREW PRODUCTS CO. INC. 55
ALUMINUM CO. OF AMERICA, MISSILES, AVIATION ORDNANCE 122
ALLIED RESEARCH ASSOCIATES, INC. 72
AMP INCORPORATED 52
AVCO CORPORATION ..... 4th Cover
AVIATION WEEK AND SPACE TECHNOLOGY 134-135

BECKMAN INSTRUMENTS, INC. 46, 61
BELL HELICOPTER CORPORATION 16
BENDIX PACIFIC DIVISION, BENDIX-AVIATION CORP. 123, 119
BENDIX COMPUTER DIVISION, BENDIX-AVIATION CORP. 56-57
BENDIX RADIO DIVISION, BENDIX-AVIATION CORP. 44
BENDIX RED BANK DIVISION, BENDIX-AVIATION CORP. 140
BOEING AIRPLANE CO. 50
BRISTOL SIDDLEY ENGINES LIMITED 48-49

CALIFORNIA GENERAL, INC. 106
CANNON ELECTRIC CO. 60
CANOGA DIVISION, UNDERWOOD CORP. 104
CLEMCO AERO PRODUCTS 13
CLIFTON PRECISION PRODUCTS CO., INC. 3rd Cover
CONSOLIDATED DIESEL ELECTRIC CORP. 64-65
CONTROL SWITCH DIV. CONTROLS CO. OF AMERICA 109
CRAIG SYSTEMS, INC. 128-129

DAYSTROM PACIFIC, DIV., OF DAYSTROM, INC. 108
DELTA AIR LINES 81
DONNER SCIENTIFIC CO. 84
DOW CORNING CORP., SILICONES 120

ELECTRONIC ENGINEERING CO. OF CALIFORNIA 95
ELECTRONIC EQUIPMENTS DIV., LITTON INDUSTRIES 157
ETHIOPIAN AIRLINES, INC. 45

FAIRCHILD ENGINE & AIRPLANE CORP., STRATOS DIV. 71
FENN MANUFACTURING COMPANY 88
FENWAL, INC. 68
ROBERTSHAW-FULTON CONTROLS, FULTON SYPHLON DIV. 63

GARLOCK INC. 96-97
GARRETT CORP., THE 92, 103
GENERAL CONTROLS CO. 76
GENERAL ELECTRIC SILICONE PRODUCTS DEPT. 62
B. F. GOODRICH CO. 22
GOODYEAR TIRE & RUBBER CO. 14-15
GROVE VALVE & REGULATOR CO. 117

HARNISCHFEGER CORPORATION 7
HAYDON A. W. COMPANY 93
HERCULES POWDER CO. 8
HI-SHEAR RIVET TOOL CO. 9
HORKEY-MOORE ASSOCIATES 100
HUGHES AIRCRAFT CO. 82
HYDRO AIRE, COMPANY 3

KEARFOTT DIVISION, GENERAL PRECISION INC. 141, 143, 145, 147

LIBRASCOPE, DIVISION, GENERAL PRECISION INC. 24
LOCKHEED AIRCRAFT CORP. 88-99
LONG-LOK CORPORATION 121

MARTIN COMPANY, THE 80-81
MB ELECTRONICS, A DIVISION OF TEXTRON ELECTRONICS INC. 70
METALS & CONTROLS DIV. OF TEXAS INSTRUMENTS INCORPORATED 74
MINNESOTA MINING & MFG. CO. 94
MISSILE DIVISION OF NORTH AMERICAN AVIATION INC. 86
MOOG SERVOCONTROLS, INC. 110
MORSE CHAIN COMPANY 118
MOTOROLA, INC., MILITARY ELECTRONICS DIV. 126-127

NICHOLS CO., W. H. 75

PARSONS CO., THE RALPH M. 79

RADIO CORP. OF AMERICA, ASTRO-ELECTRONIC PRODUCTS DIV. 124
REMINGTON RAND UNIVAC DIV. SPERRY RAND CORP. 12
REEVES SOUNDCRAFT CORP. 114
ROHR AIRCRAFT CORP. 10
ROLLWAY BEARING COMPANY 116
RYAN AERONAUTICAL CO. 148

SARGENT ENGINEERING CORP. 4
SEISCOR DIV. OF SEISMOGRAPH SERVICE CORP. 87
SERVOMECHANISMS, INC. 5
STILLMAN RUBBER CO. 146
STRATOFLEX, INC. 101

TIMKEN ROLLER BEARING CO. 17
TRANS WORLD AIRLINES, INC. 42

UNI-FLEX MANUFACTURING & ENGINEERING INC. 121
U. S. STEEL CORPORATION 136-137

VICKERS, INC., DIV. SPERRY RAND CORP. 18
VICKERS-ARMSTRONGS LIMITED 89, 90

WYANDOTTE CHEMICALS CORPORATION 77

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

WHERE TO BUY
Associated Aero Service Laboratory Inc. 155

ADVERTISERS INDEX

Ayer & Assoc. Inc. Frederick B. 156
Bendix Aviation Corp., Bendix Systems Div. 154
Central Research & Eng. Div., Continental Can Co. Inc. 154
General Electric Co. (HMED) 153
General Mills, Inc. 130
Hercules Powder Company 154
International Business Machines Corp. 152
P. L. Julius 156
Lenkurt Electric Co. Inc. 155
Minneapolis-Honeywell 150-152-155
Mitre Corporation 151
Scott Aviation Corporation 156
Texaco Inc. 156

PROBLEMATICAL RECREATIONS 14

The undergraduates of a School of Engineering wished to form ranks for a parade. In ranks of 3 abreast, 2 men were left over; in ranks of 5, 4 over; in 7's, 6 over; and 11's, 10 over. What is the least number of marchers there must have been? *—The Georgia Tech Engineer*

ANSWER TO LAST WEEK'S PROBLEM:

Let T_1 = the setting of his clock when he left home
T_2 = the setting of his clock when he returned
Then $T_2 - T_1$ = the total length of time he was away
Let t_1 = the correct time at which he arrived at his friend's home
t_2 = the correct time at which he left his friend's home
$t_2 - t_1$ = the length of time at his friend's home
Then $t_2 + \frac{1}{2}[(T_2 - T_1) - (t_2 - t_1)]$ is the correct time when he arrived home, assuming he walked at the same rate both ways.

Graduates of Schools of Engineering, who have experience in analysis and development of inertial guidance or control systems for spacecraft and aircraft applications, are invited to write to Mr. Don Krause in our Guidance Systems Laboratory.

LITTON INDUSTRIES
Electronic Equipments Div.
Beverly Hills, California

LETTERS

Silo Construction

I must take exception to the term "unique system of construction of Minuteman ICBM test silos" in the legend under the picture on p. 65 of your Apr. 4 issue.

This method has been used for quite a few years to sink well tile as I had the misfortune to learn when my father enlisted my aid in such an enterprise. The reason I consider the experience a misfortune can readily be deduced if you can picture digging through closely packed gravel while cramped inside a three-foot-diameter concrete tile. Digging in the last tile was rather hairy since the bottom tile had developed a design weakness (healthy crack) and it was doubtful which would collapse first, the tile or the digger.

This actually was not as dangerous as the day I thought my father asked me to drop in the pail we used to haul out the gravel. I obligingly dropped the bucket in the well, and ascertained from the resounding thump as it hit my father on the head and the ensuing outcry that I'd been mistaken. Fortunately the ladder was removed from the well and he was unable to scale the sheer wall. I conned a friendly neighbor into lowering the ladder after my father had an opportunity to cool off, and made myself scarce for a few days.

A study of the picture in your fine magazine indicates that such situations are hardly likely to develop with the Minuteman silos, especially due to the great technological advances of the past few decades.

D. C. JORDAN
Orlando, Fla.

Hard Landings

The FAA is quoted (AW Apr. 25, p. 40) as saying that "FAA has never taken any action against any pilot for making a hard landing." In a recent issue of the ALPA News Letter there is a list of violations filed against pilots during the last quarter of 1959 among which are four instances of violations for hard landings. Two of these are proposed suspensions of certificate. I would classify this as action.

The belief is, therefore, widespread among airline pilots that reporting a hard landing can cost you a fine or a suspension of license. Allowing the FAA the benefit of the doubt, perhaps no final action has actually been taken and it is not their policy to do so. Nevertheless the pilots believe it is so, and their belief is the important thing here.

The FAA is also quoted as saying "no experienced pilot would shirk his responsibility of reporting a hard landing even if he did face punitive action." This indicates a great deal more faith in human nature than has been expressed by them in the past. And a good deal more faith than I have. There may be just a half dozen pilots in this whole business who would not report a hard landing for fear of penalty—but one of them could kill me or you (or Gen. Quesada). But let us consider the more typical pilot who has a harder than average landing, one in which there is a genuine question in his mind as to whether this was really a "hard" landing; his experience in this category is obviously limited. With the threat of penalty in the back of his mind, he may be influenced unconsciously into rationalizing the landing into a tolerable, though harder than normal, one. Or looking at it from another point of view, we know of rare cases of hard landings going unreported in the "good" old days of CAA where the pilot was not penalized for the hard landing per se; isn't it only reasonable to assume that there would be a greater incidence of such occurrences where a penalty is threatened?

So perhaps a pilot goofs—and granted the illogical assumption that pilots should make no errors, it is far more important to me (and should be to Gen. Quesada) that I have a structurally sound aircraft to fly than that someone who didn't meet the FAA's standards be punished. Punitive action must be applied with the paramount consideration—that of over-all safety. The impression sometimes arises that the FAA is dedicated to the punishment of the "guilty" at any price—even that of safety.

Now it is not enough that the FAA might have changed its mind on the subject (under the pressure of the CAB's recommendation) and publicizes it in an obscure sentence in AVIATION WEEK. If they have changed their attitude it makes little difference if the people involved are not informed. And if perhaps we have been wrong all along in believing that this was the FAA's attitude—and the belief is widespread—then it is important that the FAA voice its view loudly and clearly.

HARRY B. MARTIN
Ann Arbor, Mich.

P. S. Let me tell you how much I enjoy reading AVIATION WEEK. Your editorials are especially appreciated, in particular in letting me see the man behind the image of Eisenhower.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Political Guts

The biographical sketch accompanying Mr. Lanphier's remarks to the National Press Club (AW Apr. 11, p. 127) indicates that he has been employed both as an editor and as a businessman. As an editor he has offered criticism of the national defense plan and in good editorial fashion has offered some solution: to spend more money. As a businessman he should remember that to advocate the application of funds without an examination of their source is bad business. He seems to believe that more debt is the only way to get more funds in a budget. At various points in his speech, Mr. Lanphier advocates guts, vigilance, activity, and bravery. Prosperity seems to be a very bad thing to him. In this he is in harmony with his fellow Cassandras; however, I assert that without it we shall lose the Total War in which we are surely engaged as quickly as by allowing our military posture to deteriorate.

Mr. Lanphier chooses to skip lightly over the fact that we are now engaged in a total war. It is economic, social and political, as well as military. Our prosperity is a definite weapon in the execution of the cold war. Has Mr. Lanphier forgotten that we have officially abandoned isolationism? If so, he is forgiven; if not, let him and the rest of his friends reflect on the fact that the strength of the dollar is today a mainstay of the economy of most of the world. If we increase our debt to spend more on defense, the strength of the dollar is weakened. Our position of world leadership is weakened proportionately. In addition, let Mr. Lanphier reflect on what he might do in defense with some of the $9 billion each year which go to pay interest on the national debt. This item is second only to defense in the national budget. Rather than reduce this item to make some of that money available for defense, Mr. Lanphier would compound the problem. If we had exercised some restraint in our budgeting since the second World War, perhaps we would have as much as half of that item available for constructive use today.

Now, a balanced budget and adequate national defense are not incompatible. If we further examine the items in this budget we find that the third largest item is for farm support. Here is a truly luxury item, perpetuated in one form or another by both political parties in a vain attempt to buy a segment of the voting population. Yet, if a real bipartisan effort was made to exercise the use of guts, vigilance, and bravery, most, if not all, of this $6 billion item could be freed for the defense of all the people. Experience has shown that no matter how much we pay the farmer to take land out of production he will find a way to produce more on what is left and continue to pile up surplus. It would seem, then, that the worst that could happen here in the long run is that the marginal farm producer would have to sell out to the efficient producer. The whole nation gets the benefit of additional defense funds with no effect on the prosperity of the majority of the people. It doesn't take a lot of hot-headed argument to get adequate defense. It just takes a little political guts, bravery, and activity to give the nation survival with prosperity.

JIM RADCLIFFE
Seattle, Wash.

Soviet Ship Names

In one of my first tests of a newly acquired proficiency via TV-Russian, I checked the names of the Soviet ships pictured on p. 79 of the Feb. 1 issue. Are the upper and center photos reversed or should I concentrate on my homework?

J. J. MULQUIN
Silver Spring, Md.

(No homework needed. Reader Mulquin is correct—Ed.).

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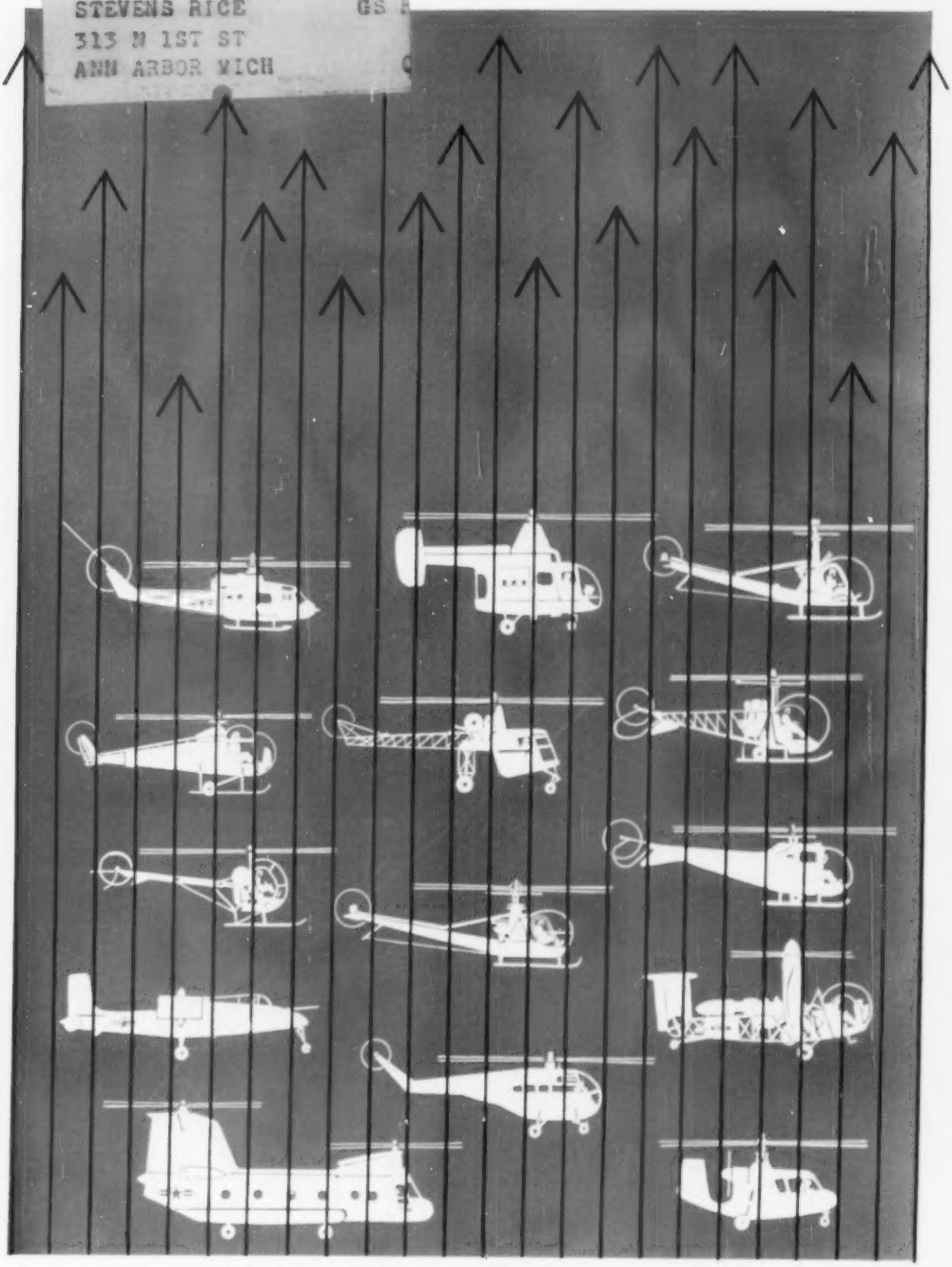

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